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American Machinist

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Volume 70 | New York, May 30, 1929 | Number 22

A Code System for the Small Shop

By E. A. Terrell
President, Terrell Machine Company

A system of records by which the sub-assemblies and components of any machine manufactured can be quickly identified

IN BUILDING standardized machines adaptable to widely-varying conditions and adjustments, we found that after we had designed, built and sold them, we had not solved the problem of keeping accurate track of the details of the equipment furnished with each machine. Analysis showed that there were the two following classes of variables:

1. Parts for the same purpose, but of different sizes and shapes, were frequently required. Usually such parts are interchangeable, one being readily used in place of another.

2. Parts or attachments that can be used with the main assembly, but which are not interchangeable with other parts or attachments of similar design.

For variables of class 1, where the parts are interchangeable with one another, a general part number can be assigned in the parts catalog, provided a record is kept of the specific part used. This number should not be the actual part number, but instead should be a key number indicating that the record sheet is to be consulted before entering an order for replacement.

For variables of class 2, it is usually necessary to prepare separate catalog sheets for the user, since the parts are more or less special. In both cases, it is a time-consuming job to record each and every part used on a machine, and unless the work is done by one who has special training and knowledge there will be much confusion and expense in filling orders for repairs.

We use a code sheet for each machine shipped. With this code, it is possible to keep a detailed record of the exact equipment used on each machine. The writing is reduced to a minimum and the probability of error is greatly reduced. The master record is kept in the home office and copies are supplied to agents. This is a necessary procedure in our case, because we stock repair parts at three different points for quick delivery. Fortunately, such a code is easy to prepare and simple to keep. The records required are: A code book, a list of sub-assemblies and a record sheet for each machine.

Nearly everyone is familiar with the main sub-assemblies of an automobile. They consist of the following: The motor, the frame, the front axle, the rear axle, the transmission, the radiator, the body and the wheels. These divisions tell nothing about the parts comprising them. The terms are generic, meaning "any motor" or "any frame," etc. They simply serve as an index to tell what sub-assembly is referred to. Having made these primary divisions, the preparation of the code book can be commenced. Assume that the concern used as an example builds, or uses, three different kinds of motors; a four cylinder, a six cylinder and an eight cylinder; and that there are three different frames used, each intended for one of the motors but so designed that any one of the motors can be used with any one of the frames. This gives nine possible combinations of motors and frames. If the remaining assemblies are equally interchangeable, there will be fifty-six possible combinations.

Starting with motors, Table I shows the major parts and their sub-assemblies. One division of the code book

MOTORS		
Code Division	Description	Code No. 1
1.1	A 4 Cylinder Motor. See Sub-Assembly A-1 for list of parts and specifications.	
1.2	A 6 Cylinder Motor. See Sub-Assembly A-2 for list of parts and specifications.	
1.3	An 8 Cylinder Motor. See Sub-Assembly A-3 for list of parts and specifications.	

Fig. 1 — Specimen sheet of one division of the code book

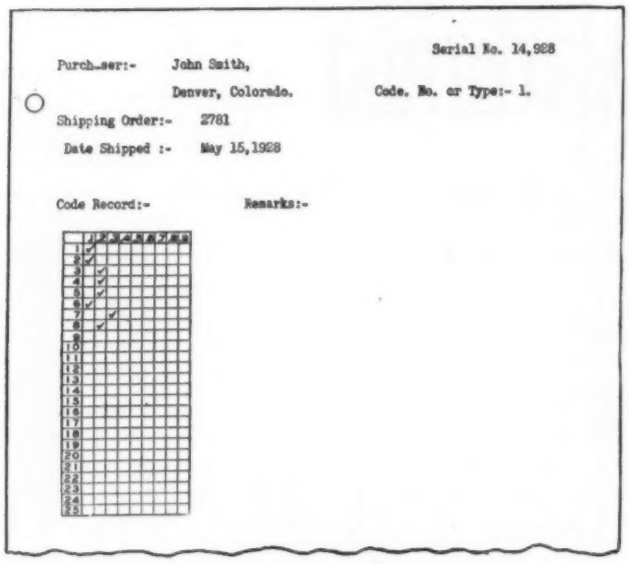


Fig. 3 — The permanent record sheet

is prepared for each of the divisions listed. A specimen sheet covering one division is given in Fig. 1. It is preferable to have not more than nine sub-heads under each major sub-division. Thus, if more than three styles of bodies are to be built for each motor, it would be better

Table I—Component Parts and Their Sub-Assemblies

1.	Motors (General)
1.1	4-cylinder motor (Sub-assembly A-1)
1.2	6-cylinder motor (Sub-assembly A-2)
1.3	8-cylinder motor (Sub-assembly A-3)
2.	Frames (General)
2.1	Frame for 4-cylinder motor (Sub-assembly B-1)
2.2	Frame for 6-cylinder motor (Sub-assembly B-2)
2.3	Frame for 8-cylinder motor (Sub-assembly B-3)
3.	Front axles (General)
3.1	Front axle for 4-cylinder motor (Sub-assembly C-1)
3.2	Front axle for 6-cylinder motor (Sub-assembly C-2)
3.3	Front axle for 8-cylinder motor (Sub-assembly C-3)
4.	Rear axles (General)
4.1	Rear axle for 4-cylinder motor (Sub-assembly D-1)
4.2	Rear axle for 6-cylinder motor (Sub-assembly D-2)
4.3	Rear axle for 8-cylinder motor (Sub-assembly D-3)
5.	Transmissions (General)
5.1	Transmission for 4-cylinder motor (Sub-assembly E-1)
5.2	Transmission for 6-cylinder motor (Sub-assembly E-2)
5.3	Transmission for 8-cylinder motor (Sub-essembly E-3)
6.	Radiators (General)
6.1	Radiator for 4-cylinder motor (Sub-assembly F-1)
6.2	Radiator for 6-cylinder motor (Sub-assembly F-2)
6.3	Radiator for 8-cylinder motor (Sub-assembly F-3)
7.	Bodies (General)
7.1	Body for 4-cylinder coupe (Sub-assembly G-1)
7.2	Body for 4-cylinder sedan (Sub-assembly G-2)
7.3	Body for 4-cylinder open (Sub-assembly G-3)
7.4	Body for 6-cylinder coupe (Sub-assembly G-4)
7.5	Body for 6-cylinder sedan (Sub-assembly G-5)
7.6	Body for 6-cylinder open (Sub-assembly G-6)
7.7	Body for 8-cylinder coupe (Sub-assembly G-7)
7.8	Body for 8-cylinder sedan (Sub-assembly G-8)
7.9	Body for 8-cylinder open (Sub-assembly G-9)
8.	Wheels (General)
8.1	Wire wheels (Sub-assembly H-1)
8.2	Disk wheels (Sub-assembly H-2)
8.3	Artillery wheels (Sub-assembly H-3)

Table II—Interpretation of Code Division Chart

Code Division	Meaning	
1.1	4-cylinder motor	(Sub-assembly A-1)
2.1	Frame for 4-cylinder motor	(Sub-assembly B-1)
3.2	Front axle for 6-cylinder motor	(Sub-assembly C-2)
4.2	Rear axle for 6-cylinder motor	(Sub-assembly D-2)
5.2	Transmission for 6-cylinder motor	(Sub-assembly E-2)
6.1	Radiator for 4-cylinder motor	(Sub-assembly F-1)
7.1	Open body for 4-cylinder motor	(Sub-assembly G-3)
8.2	Disk wheels	(Sub-assembly H-2)

to assign to each group a separate major division and to designate them as follows: 7, four-cylinder bodies (General); 8, six-cylinder bodies (General); and 9, eight-cylinder bodies (General). However, in this case, the subject will be continued with but one major division.

The next step is to prepare the sub-assembly sheets A very satisfactory form for these sheets for use in small- and medium-sized shops is shown in Fig. 2. In this sheet is given the details of the sub-assembly A-1, the four-cylinder motor. The horizontal lines are ruled by hand after the sheet has been typed. While our concern has never built any automobile motors, it is assumed that there will be plenty of openings for criticism in regard to the specifications listed on this sheet. However, they are offered, not as exact specifications, but merely as examples.

From the sub-assembly sheet, it is a very simple matter to tell just what parts were used whenever an assembly is indicated by the code. Similar assembly sheets are prepared for each of the remaining divisions. After this has been done, the next step is to prepare the record sheet. This sheet is for keeping a detailed record of each machine shipped. The form shown in

A-1 — 4 Cylinder Motor Sub-Assembly

1 — A-196

This sub-assembly is purchased from Jones & Co., Detroit, Mich.

Per Mch	Part No.	Part Name	Screws, etc.
1	A-111	Cylinder Block	8 Studs, No. A-112 8 S.A.E. Castellated hex nuts, 1/2 in. 8 Lock washers, 1/2 in. 8 Cotter pins, 1/16x3/4 in.
1	A-113	Cylinder Block Cap	16 S.A.E. Hex capscrews,3/8x1 in. 1 Copper gasket, A-114
1	A-115	Crank Case Top	16 S.A.E. Hex capscrews,1/2x1-1/2 16 Lock washers, 1/2 in. 1 Gasket, A-116
1	A-117	Crank Case Bottom	8 S.A.E. Hex capscrews, 3/8x1 in. 8 Lock washers, 3/8 in. 1 Drain plug, 1/8-in. pipe
4	J-217	Pistons	12 Piston rings, No. 142
4	J-218	Wrist Pins	
4	A-118	Connecting Rods	8 Studs, A-119
4	A-120	Connecting Rod Caps	8 S.A.E. Castellated hex nuts, 3/8 in. 8 S.A.E. Plain washers, 3/8 in. 8 Cotter pins, 3/32x3/4 in.
1	J-201	Crank, with special nut and washer on timing gear end.	
4	L-180	Exhaust Valves	
4	L-181	Exhaust Valve Springs	
4	L-182	Intake Valves	
4	L-183	Intake Valve Springs	
1	J-202	Cam Shaft	
1	A-121	Intake Manifold	8 S.A.E. Hex capscrews, 3/8x3/4 in. 8 Lock washers, 3/8 in. 1 Gasket, A-122
1	A-123	Exhaust Manifold	8 S.A.E. Hex capscrews, 3/8x3/4 in. 8 Lock washers, 3/8 in. 1 Gasket, A-124
1	A-125	Timing Gear	
1	A-126	Cam Shaft Gear	
1	A-127	Idler Gear	1 Stud, A-128

Fig. 2 — The sub-assembly sheet

Fig. 3 should be found satisfactory in most cases. The information recorded may vary according to the requirements of the business. The code-division chart may be longer or shorter, as desired. On the chart, the divisions checked constitute the code record of an automobile sold to John Smith. In Table II, the interpretation of the code is given.

What has been said applies to a plant building one general product, although the record system will fit the requirements of a plant making several different products. In fact, there is no limit to the expansion of the system to cover different types of machines or products. All that is necessary is to have a separate index for each machine, and to give the code covering that machine its own particular number. Thus, code 1 may cover a horizontal milling machine; code 2 a turret lathe; and code 3 a centerless grinder. In the example chosen a separate index may be prepared for each of the automobiles; one for the four-cylinder car; another for the six-cylinder, and a third for the eight-cylinder. By using different indexes for different products, it is possible to record almost any kind of product.

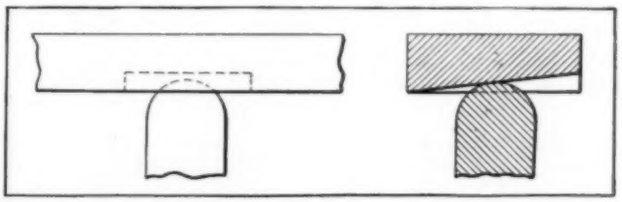
In our plant, the foreman fills out the record sheet just before the machines are crated for shipment. He has a copy of the code book, and on the back of the shipping order there is printed a record form, identical with that shown in Fig. 3. He then turns the form over to the office so that bills of lading, shipping tags, etc. can be made out, and his record is checked by the bookkeeper. Later, at his convenience, the foreman copies the information from the back of the shipping order on to the permanent record sheet.

The checker also has a code book. When an order for parts is received from a user of our machines, the bookkeeper checks the order for accuracy, using his code book and his record sheet to be sure that the parts are the proper ones for the machine sold to that particular user.

Typical Vise Jaws and Vise Fixtures
Discussion

By Forrest L. Johnson

THE design of the quick-acting vise jaw shown at the top of page 603, Vol. 70, of the *American Machinist* shows excessive bearing surface in contact between the 7-deg. angle on the swing clamps and on the



Suggested changes in form of contact surface, between swing clamp and support stud

top of the support stud. This has a tendency to tilt the swing clamps, thereby preventing full contact with the work.

To correct this defect it is suggested that the top of the support stud be made a hemisphere as shown in the illustration. The "layout" shown would be less confusing if the illustrations were turned 90 deg. counter-clockwise, and the terms "Push to clamp" and "Pull to release" were used instead of arrows.

SEEN · AND · HEARD

By John R. Godfrey

The Cost of Belting—Cutting Tool Alloys—Chromium Plating

KEEPING track of belt costs is one of the signs of an awakening in shop management. Up to a few years ago little except direct labor costs seemed to be of special interest. Most of the efforts of management was given to reducing the time required by machine operations. Higher speeds, new tools, and special methods held the center of the stage. Now, fortunately, we are finding attention turning to other costs than direct labor. The efforts are bound to result in marked economies.

* * *

STEEL has been used for cutting tools for such a long period that we seem to think of nothing else when we talk of tools. It is probably safe to say that at least 90 per cent of those using any of the new cutting alloys think of them as a kind of steel. In reality they are not steel at all but any alloy of a different type. Yet Borium, Carboloy, Stellite, Straus metal, and Widia are all used as though they were the names of *steels*. Not that it probably matters or causes any great confusion. It tends, however, to show how firmly steel is fixed in our minds as a cutting tool.

And, incidentally, it is rather surprising to find that a large number of small shops are trying out these new cutting alloys. Some of them will doubtless decide that they are not worth the cost, while others will find great economy in their use. Many of the failures can probably be traced directly to the machines in which the tools are used not being rigid enough for the work. Successes may, in some cases at least, be due to selecting the best work and the best conditions. Even though the actual machining time may not be reduced, the saving in idle time due to less grinding time required may show economy. And on machines built for the new tools, savings are likely to be found in both directions. But steel is not going to be discarded for many moons. Both types of cutting tools will have their place. The task is to find the field for which each is best adapted.

* * *

CHROMIUM plating has introduced a new procedure in using it as a finish. Unlike other electro-plated finishes it cannot be polished successfully but reflects the surface on which it is plated. So in plating steel it is customary to first copper and then nickel plate in the usual way, the nickel being highly polished before chromium is applied.

On brass work, however, the preliminary platings can be omitted and a brilliant finish given with chromium if the metal is given a high finish in the machine. I recently saw a brass piece just as it came from a bench lathe, that had been turned and burnished at the same time, using a diamond tool. The tool had evidently been so shaped that it had a small bearing, or burnishing surface behind the cutting edge, and the work was as highly polished as though it had come from a rag wheel. When work to be plated can be so machined as to need no further polishing, we have advanced another step in the elimination of labor.

A Novel Reward for Shop Improvements

"PRIZES for ideas," said old John Brewster, of the Wagon Works, "cause a lot of grief in the average shop. Just now I've got a case that is sort of puzzling me. We offer prizes for suggestions that help out in the shop, and it's often a problem to know how to pay for them when they amount to anything."

"We give a flat price of five dollars for any that we accept," piped up Jim Jeffrey. "And believe me, boys, they aren't worth that in many cases. But it's the simplest way I know of."

"Simple enough, Jim," said Watson, another shop manager at the table, "but you probably only get five-dollar ideas. What do you expect when you don't make it at all worth while?"

"But it's all velvet to the men, Watson. And it's a lot better than nothing."

"I'm not dead sure of that, Jim. If the idea is any good it saves you a lot more than five bucks—and the men know it. They don't bother to tell you of anything worth while because they haven't any incentive. We graduate our prizes from fifty dollars down to five. Even that isn't a really good way, but fifty looks a lot bigger than five, and it does stir them up at times. But what's bothering you, Mr. Brewster?"

"One of our boys got up a little attachment for a milling machine that speeded up the output appreciably. Saved quite a bit of scrap also. It's a simple thing and it's a wonder the designer didn't get wise to it himself. The chap who made it hadn't even put in a claim for a prize. In fact he was afraid I was going to bawl him out for putting it on the machine without asking me about it first. It's saving us perhaps a dollar a day, and that's the interest on about five thousand dollars. What should I give him for it?"

"Now don't go and get chicken hearted, Mr. Brewster, or you'll spoil the men in all the shops. He didn't expect anything but his increased pay check, due to more production. Why not give him fifty and forget it?" replied Watson.

"That might be all right if this was the only case we'd ever had, Watson. But I want to have some sort of a fair plan that will make the rest of the boys in the shop keep on their toes to make similar improvements. If I make it worth while for them, they'll spring some new ideas that may help even more than this. How would it do to give him a quarter of the saving, Bill?" he said turning to Bill Holland. "Ever know of that being done?"

"Yes, I have, John, and it has worked out well. I wouldn't put it in the pay envelope, but give it to him separately at the end of the month. He'll like it better, and he won't get to thinking of it as part of his pay. He can buy the missus something extra with it or he can hold it out on her, if he thinks he's justified. But it works better as an extra.

"One trouble is to figure out just what is fair to you both—but your proportion seems O.K. for most cases. For after all he couldn't save it except with the tools you provide."

"Any other plans, Mr. Holland?" asked Watson.

"I ran into a new one once, Watson, that interested me because it was so different. This was a case similar to Mr. Brewster's. The manager saw the application of the new device and had his lawyer draw up patent papers for it. Then he called the young man in the office and asked him to sign—not the patent, but the shop rights over to him. The patent was taken out in the man's own name, paid for by the company and presented to the man. That was his prize for developing the idea. And the manager feels pretty sure that some machine builder will be around bidding for the patent when he finds out about it."

"Seems a round about way to reward a man, why not pay him and let him get his own patent?"

"Perhaps it isn't a very democratic way, Jim. But this manager believes he's put the man in the way of making several thousand dollars. And he's going to help him get it. He's given the man the notion that his idea has merit, and has also shown him that the firm plays the game squarely with its men. He could have hogged the patent if he'd been so minded.

"And don't forget that the man won't keep this

incident under his hat. It will circulate all over the shop, and the lure of possible profits will stir up more ideas than the average prize."

"I'm afraid the man will get a swelled head, Holland," said Jeffrey. "Seems better to me to pay them all alike and prevent jealousy."

"Bunk," said Watson, and the others joined in the chorus. "He may get a swelled head, but not because all prizes are not of the same value."

Executives are invited to discuss the problem involved in the foregoing case. They are also urged to use this department to air their own problems. A letter to the Executive Forum Editor is all that is needed.

Discussion

Can Shop Losses be Charged to Sales?

If it is necessary for a shop to furnish certain articles at a loss so that orders may be secured for other articles, this loss appears to be just as much a part of the sales expense as a salesman's salary, or any other direct expense of the sales department. Suppose the sales department wanted to distribute some article to prospective customers free of charge, and had a choice of purchasing these articles outside, or of having them made in the shop. In either case the cost would be charged to the sales department. The only difference between this transaction and the one of the Lewis Company, is that in the latter case a portion of the cost is paid by the customer. It therefore seems only logical that the balance should be charged to the sales department.

If this practice were followed, the expense would be a spur to the salesman to encourage them to get a better price for the special article, or to get the regular order without taking the part which carries the loss. Salesmen, like other human beings, are prone to take the path of least resistance, which, in this case, means taking some orders at a loss. A few thorns in the way of costs thrown in this path will make it less easy to travel. —C. J. MORRISON.

Discouraging Rush Orders

The extra costs and upsetting effects of rush orders on existing schedules cannot be stressed too strongly. The fundamental difficulty lies in too much routine contact between "firms" and not enough real contact between major executives. The purchasing agent receives a rush purchase order. Very often there's little left to him "but to do or die." So he passes it on in the same imperative manner to the salesman. When the salesman accepts it, and duly emphasizes the rush in forwarding it, the order becomes mandatory on his firm to make good. Yet, by the very formal nature of this contact, a real check-up never occurs at the point of origin as to whether the rush is necessary, or not..

Yet there should be enough real, personal contact between the major executives of the two firms, so that some executive of the selling firm couuld call up a corresponding executive of the purchasing firm and say, "Bill," will you please check up for me on Order No. 1016, and tell me how soon you really must have it? I know the order says 'rush,' and I'm ready to do anything for you. But if you can grant me as much time as possible, it would surely save some other jobs from being delayed, and I'd appreciate it." Such a procedure is a lot more effective than just formally cancelling or refusing the order.

After all, it's the ability to see the other fellow's viewpoint that makes executives. There is no reason why two firms should continue to do business for years without ever getting together personally. And in the last analysis, it should be borne in mind that, once it is known that a "big boss" is likely to check on the necessity for a rush order, the liklihood of unnecessary "rushes" is greatly minimized. —FRANK KAHN.

Getting Men From Other Industries

While for detail shop jobs it is best to get men thoroughly experienced in the particular line of work to be done, when it comes to a supervising position, such as shop superintendent, the man himself is the important factor. Mere detail knowledge should not be the criterion.

In addition, every organization must at times be inspired with new ideas, often adapted from other plants. A man who has had real experience in other industries, and who knows how to make plans succeed, possesses a fund of knowledge which is not restricted to the particular industries in which he acquired it. Fundamentals are of real significance to a superintendent, no matter what the product is to which they may be applied.

Hence, bringing in a new superintendent who has all qualifications save that of direct experience in the industry concerned, may be a real boon to the organization. The superintendent who is equipped chiefly with detailed knowledge may be good as long as conditions remain the same, and yet become almost a total loss as shop practices change and develop. The possession of basic information and the ability to "start things" are the real qualifications of a good superintendent. —NELSON H. PATTON.

Proposed Standard Practice for
Gear Materials and Blanks

Tentative American recommended practice submitted by the American Standards Association for criticism and comment

UNDER the joint sponsorship of the American Society of Mechanical Engineers and the American Gear Manufacturers' Association, the American Standards Association is offering for comment the following proposed American recommended practice for specifications of gear materials and blanks of alloy steel, cast steel, forged and rolled carbon steel, bronze and brass. The work of compiling this proposed standard was undertaken by Sub-Committee No. 8 of the Committee on the Standardization of Gears of the A.S.M.E. in conjunction with a similar committee of the A.G.M.A. T. D. Lynch, consulting metallurgical engineer of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, was chairman of this committee. Clifford B. Le Page is acting secretary of the general committee on gear standardization and any suggestions or comments should be addressed to him at 29 West 39th Street, New York. The present standard is the fourth to be submitted by the gear committee. Tentative standards on the 14½-deg. composite system and the 20-deg. stub involute system have been approved, and a proposed standard on the 14½- and 20-deg. full-depth involute systems together with a proposed standard on the inspection of gears are now under consideration.

Carbon Steel

1. MATERIAL COVERED. This specification covers steel for gears in three groups, according to heat-treatment, as follows: (*a*) case hardened gears, (*b*) unhardened gears, not heat-treated after machining, and (*c*) hardened and tempered gears.

2. BASIS OF PURCHASE. Forged or rolled gear steels shall be purchased on the basis of the requirements as to chemical composition specified in the following table. Requirements as to physical properties have been omitted, but when they are called for the requirements as to carbon shall be omitted.

3. PROCESS. The steels may be made by either or both the open-hearth and electric furnace processes.

4. DISCARD. A sufficient discard shall be made from each ingot to secure freedom from injurious piping and undue segregation.

5. CHEMICAL COMPOSITION. Forged and rolled carbon steel for use in gears shall conform to the requirements, as to chemical composition as indicated in Table I. Class N steel will normally be ordered in ten point carbon ranges within these limits.

6. LADLE ANALYSIS. An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of the elements specified. This analysis shall be made from drillings taken at least ¼ in. beneath the surface of a test ingot obtained during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative, and shall conform to the requirements which have been specified.

7. CHECK ANALYSIS. Analysis may be made by the purchaser from one or more bars or forgings representing each melt. The chemical composition thus determined shall conform to the requirements specified above. Drillings for analysis shall be taken at any point not closer to the center than midway between the center and the surface, but not within ¼ in. of the surface of the bar or forging.

8. FINISH. The material shall be free from injurious defects and shall have a workmanlike finish. Cold-finished bars shall have a bright, smooth surface.

9. MARKING. (*a*) The melt number shall be legibly stamped on each bar or forging 4 in. or over in thickness, and on those of smaller section when so specified. The number stamped on gear blanks shall be placed on the web or in such a position that it will not be obliterated in machining operations. (*b*) The identification marks specified on the order to be stamped on gear blanks shall be placed on the web or in such a position that they will not be obliterated in machining.

10. INSPECTION. The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

11. REJECTION. (*a*) Unless otherwise specified, any rejection based on tests made in accordance with this specification shall be reported within ten working days from the receipt of samples. (*b*) Material which shows injurious defects while being finished by the purchaser will be rejected, and the manufacturer shall be notified of it.

12. REHEARING. Samples tested in accordance with this specification which represent rejected material, shall

Table I—Chemical Composition of Forged and Rolled Carbon Steel for Use in Gears

Use	Class	Carbon	Manganese	Phosphorus	Sulphur
Casehardened	C	0.15 to 0.25	0.40 to 0.70	max. 0.045	max. 0.055
Untreated	N	0.25 to 0.50	0.50 to 0.80	max. 0.045	max. 0.055
Hardened (or untreated)	H	0.40 to 0.50	0.40 to 0.60	max. 0.045	max. 0.055

be preserved for two weeks from date of test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

Cast Steel

1. GENERAL. It is recommended that steel castings for cut gears be purchased on the basis of chemical analysis, that only two types of analysis be used, one for casehardened gears and the other for both untreated gears and those which are to be hardened and tempered.

2. PROCESS. The steel is to be made by the open hearth, crucible or electric furnace processes. The converter process is not recognized and its use is to be only by private arrangement between the interested parties.

3. DISCARD. Sufficient risers shall be provided to secure soundness and freedom from undue segregation. Risers shall not be broken off the unannealed castings by force. Where risers are cut off with a torch the cut shall be at least ½ in. above the surface of the castings, and the remaining metal removed by chipping, grinding, or other non-injurious method.

Table II—Chemical Composition of Cast Steel for Use in Gears

Use	Class	Carbon	Manganese	Phosphorus		Sulphur
				Acid	Basic	
Casehardening..	C	0.15—0.25	0.40—0.60	0.06 max.	0.05 max.	0.06 max.
Untreated or hardened....	H	0.30—0.40	0.40—0.60	0.06 max.	0.05 max.	0.06 max.

4. CHEMICAL COMPOSITION. Steel for use in gears shall conform to the requirements, as to chemical composition as indicated in Table II.

5. HEAT TREATMENT. All steel castings for gears must be thoroughly normalized or annealed, using such temperature and time as will entirely eliminate the characteristic structure of unannealed castings.

6. LADLE ANALYSIS. An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of the elements specified. This analysis shall be made from drillings taken at least ¼ in. beneath the surface of a test ingot obtained during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative, and shall conform to the requirements specified.

7. CHECK ANALYSIS. Analyses may be made by the purchaser from one or more castings representing each melt. The chemical composition thus determined shall conform to the requirements specified above. Drillings for analysis shall be taken at any point not closer to the center than midway between the center and the surface, but not within ¼ inch of the surface of the casting.

8. FINISH. *(a)* The castings shall conform substantially to the shapes and sizes indicated by the patterns or drawings submitted by the purchaser. When dimensioned drawings are provided, the foundry shall take all responsibility for correctness as to shrinkage.

(b) The castings shall be free from injurious defects and have a workmanlike finish. Defects which do not impair the strength of the castings may be welded by an approved process in a manner satisfactory to the purchaser. The metallic electrode method of electric welding is an approved process. No welding shall be done in a manner to conceal defects. The defects shall be cleaned out to solid metal before welding, and when so required by the inspector, shall be submitted to him in this condition for his approval. All steel castings welded by the foundry shall be heat-treated after welding before delivery to purchaser.

9. MARKING. The melt number and foundry symbol shall be legibly stamped or cast on each casting 6 in. or over in thickness or diameter and on castings of smaller section when so specified.

10. INSPECTION. *(a)* The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the castings ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the castings are being furnished in accordance with these specifications.

(b) If in the case of important castings for special purposes, surface inspection in the green state is required, this shall be so specified in the order.

(c) All tests (except check examination for analysis and annealing) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

11. REJECTION. Castings which show injurious defects or fail to pass check examinations as to chemistry or heat-treatment subsequent to their acceptance at the manufacturer's works will be rejected and the manufacturer shall be notified.

12. REHEARING. Samples tested by the purchaser, which represent rejected castings, shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the tests the manufacturer may make claim for a rehearing within that time.

Alloy Steel

1. MATERIAL COVERED. This specification covers alloy steel for gears, in two classes according to heat-treatment, as follows: *(a)* casehardened gears, and *(b)* hardened and tempered gears.

2. BASIS OF PURCHASE. Forged and rolled alloy gear steels shall be purchased on the basis of the requirements as to chemical composition specified in Table III. Requirements as to physical properties have been omitted.

3. PROCESS. The steel shall be made by either or both the open-hearth and electric furnace process.

4. DISCARD. A sufficient discard shall be made from each ingot to secure freedom from injurious piping and undue segregation.

5. CHEMICAL COMPOSITION. The chemical composition shall conform to requirements stated in Table III.

6. LADLE ANALYSIS. An analysis of each melt of steel shall be made by the manufacturer to determine the percentage of the elements specified. This analysis

shall be made from drillings taken at least ⅛ in. beneath the surface of a test ingot obtained during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative and shall conform to the requirements specified.

7. CHECK ANALYSIS. Analyses may be made by the purchaser from one or more bars or forgings representing each melt. The chemical composition thus determined shall conform to the requirements specified above. Drillings for analysis may be taken at any point midway between the center and the surface of solid forgings or bars, or cuttings may be taken off the entire end surface; when sampling, the surface material for a depth of at least ⅛ in. shall be discarded.

8. FINISH. The material shall be free from injurious defects and shall have a workmanlike finish. Cold finished bars shall have a bright, smooth surface.

9. MARKING. (*a*) The melt number shall be legibly stamped on each bar or forging 4 in. or over in thickness, and on those of smaller section when so specified.

(*b*) The identification marks specified on the order to be stamped on gear banks shall be placed on the web or in such position that they will not be obliterated in machining.

10. INSPECTION. The inspector representing the purchaser shall have free entry at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications.

11. REJECTION. (*a*) Unless otherwise specified, any rejection based on tests made in accordance with this specification shall be reported within ten working days from the receipt of samples.

(*b*) Material which shows injurious defects while being finished by the purchaser will be rejected and the manufacturer shall be notified.

12. REHEARING. Samples tested in accordance with this specification which represent rejected material, shall be preserved for two weeks from date of test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

Table III—Chemical Composition of Forged and Rolled Alloy Steel for Gears

No.	Carbon	Manganese	Phos. Max.	Sulph. Max.	Nickel	Chromium	Vanadium Min. desired	Molybdenum
2315	0.10–0.20	0.30–0.60	0.04	0.05	3.25–3.75	.....	.....	.....
2350	0.45–0.55	0.50–0.80	0.04	0.05	3.25–3.75	.....	.....	.....
2512	0.17 max.	0.30–0.60	0.04	0.05	4.75–5.25	.....	.....	.....
3115	0.10–0.20	0.30–0.60	0.04	0.05	1.00–1.50	0.45–0.75	.....	.....
3215	0.10–0.20	0.30–0.60	0.04	0.045	1.50–2.00	0.90–1.25	.....	.....
3250	0.45–0.55	0.30–0.60	0.04	0.045	1.50–2.00	0.90–1.25	.....	.....
3312	0.17 max.	0.30–0.60	0.04	0.045	3.25–3.75	1.25–1.75	.....	.....
3340	0.35–0.45	0.30–0.60	0.04	0.045	3.25–3.75	1.25–1.75	.....	.....
6120	0.15–0.25	0.30–0.60	0.04	0.045	.....	0.80–1.10	0.15–0.18	.....
6150	0.45–0.55	0.50–0.80	0.04	0.045	.....	0.80–1.10	0.15–0.18	.....
4615	0.10–0.20	0.30–0.60	0.04	0.045	1.50–2.00	.....	.....	0.20–0.30

All figures are expressed in per cent.

Bronze and Brass

1. MATERIAL COVERED. These specifications cover non-ferrous metals for spur, bevel and worm gears, bushings and flanges for composition gears.

2. BASIS OF PURCHASE. This material shall be purchased on the basis of chemical composition.

3. PROCESS. The alloys may be made by any approved method.

4. USE AND CHEMICAL COMPOSITION. (*a*) For spur and bevel gears, hard cast bronze, A.S.T.M. B-10-18, S.A.E. No. 62, and the well-known 88-10-2 mixture to the following limits:

	Per Cent
Copper	86-89
Tin	9-11
Zinc	1- 3
Lead	0.20
Iron (Max.)	0.06

Good castings made from this bronze should give the following minimum physical characteristics:

Ultimate strength	30,000 lb. per sq.in.
Yield point	15,000 lb. per sq.in.
Elongation in 2 in.	14 per cent

(*b*) For bronze worm gears, two alternative analyses of phosphor bronze are recommended, S.A.E. No. 65 and No. 63.

S.A.E. No. 65, called phosphor gear bronze.

	Per Cent
Copper	88-90
Tin	10-12
Phosphorus	.1-0.3
Lead, zinc and impurities (Max.)	0.5

Good castings made from this alloy should give the following minimum physical characteristics:

Ultimate strength	35,000 lb. per sq.in.
Yield point	20,000 lb. per sq.in.
Elongation in 2 in.	10 per cent

S.A.E. No. 63, called leaded gun metal.

	Per Cent
Copper	86-89
Tin	9-11
Lead	1-2.5
Phosphorus (Max.)	0.25
Zinc and impurities (Max.)	0.50

Good castings made of this alloy should give the following minimum physical characteristics:

Ultimate strength	30,000 lb. per sq.in.
Yield point	12,000 lb. per sq.in.
Elongation in 2 in.	10 per cent

These alloys, especially No. 65, are adapted to chilling for hardness and refinement of grain. No. 65 is to be preferred for use with worms of great hardness and fine accuracy. No. 63 is to be preferred for use with unhardened worms.

(*c*) For bronze bushings for gears, S.A.E. No. 64 is recommended as satisfactory, of the following analysis:

	Per Cent
Copper	78.5-81.5
Tin	9 -11
Lead	9 -11
Phosphorus	0.05-0.25
Zinc (Max.)	0.75
Other impurities (Max.)	0.25

Good castings of this alloy should give the following minimum physical characteristics:

Ultimate strength	25,000 lb. per sq.in.
Yield point	12,000 lb. per sq.in.
Elongation in 2 in.	8 per cent

(*d*) For brass flanges for composition pinions, A.S.T.M. B-20-32, and S.A.E. No. 40 is recommended. This is a good cast red brass, of sufficient strength and hardness to take its share of load and wear under conditions of style No. 2 of the A.G.M.A. standards for composition gearing, a design in which the flanges mesh with the mating gear, and therefore ample for style No. 1. The composition is as follows:

	Per Cent
Copper	83 -86
Tin	4.5- 5.5
Lead	4.5- 5.5
Zinc	4.5- 5.5
Iron (Max.)	0.35
Antimony (Max.)	0.25
Aluminum	None

Good castings made from this alloy should give the following minimum physical characteristics:

Ultimate strength	27,000 lb. per sq.in.
Yield point	12,000 lb. per sq.in.
Elongation in 2 in	16 per cent

5. Chemical Analysis. An analysis of each melt shall be made by the manufacturer. The chemical composition thus determined shall be reported to the purchaser or his representative and shall conform to the above specifications.

6. Sampling. (*a*) The sample for chemical analysis may be taken either by sawing, drilling, or milling the casting, or test coupon, and shall represent the average cross-section of the piece.

(*b*) The saw, drill, cutter or other tool used shall be thoroughly cleaned. No lubricant shall be used in the operation, and the saw dust or metal chips shall be carefully treated with a magnet to remove any particles of iron.

7. Inspection. (*a*) Inspection may be made at the manufacturer's works where castings are made, or at the point which they are received, at the option of the purchaser.

(*b*) If the purchaser elects to have inspection made at the manufacturer's works, the inspector representing the purchaser shall have free entry at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications. All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

8. Rejection. Castings which show injurious defects revealed by machining operations subsequent to acceptance may be rejected, and, if rejected, shall be replaced by the manufacturer free of cost to the purchaser. The full weight of the original material rejected shall be returned to the manufacturer.

Power-Driven Conveyors in Small Plants

By George H. Gunn

MANY manufacturers and engineers are under the impression that power-driven conveyors of different types are suitable only for very large plants employing thousands of men. It is true that power-driven conveyors find their most important application in large shops. Where large quantities of material have to be carried comparatively long distances from department to department, conveyors are indispensable. But a growing number of smaller shops have recently installed conveyor systems and have found it possible to speed up production and as a corollary to reduce costs through their use.

One advantage of conveyor systems, in small as well as large plants, is that they can be timed in accordance with the rate of speed at which the machining operations on various parts are performed. A predetermined production per day can thus be maintained, because every operation must be completed in a given time. This principle, first extensively applied in the manufacture and assembling of automobiles, has later been applied in similar work on radio parts, electrical equipment, instruments, and many other products. When a bonus is paid for maintaining the predetermined production, the system enables workmen to earn higher wages, so that both employer and employee are equally benefited by this means of increasing the output. The work of the shop men, instead of being harder, is made easier, since lifting and handling of heavier pieces are avoided. Fewer accidents also result.

Make the Specifications Specify

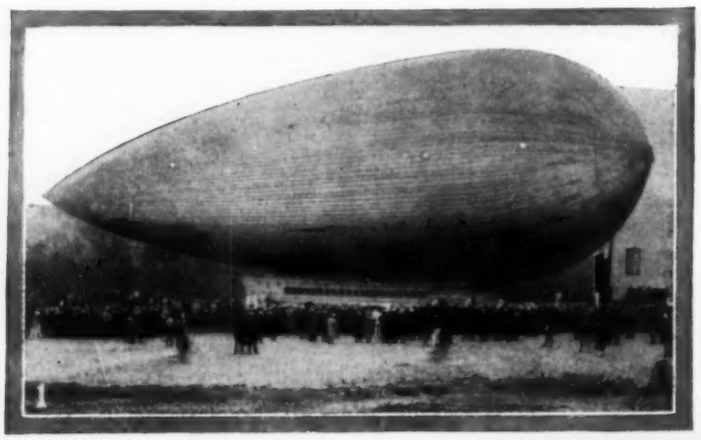
By C. Greenstein

MOST engineering specifications contain the word "or equal" to give the engineer latitude in determining which materials or products represent the biggest value to the manufacturer or builder. There is a tendency on the part of some suppliers or contractors in figuring specifications to ask themselves, "What can I get away with through the latitude allowed in the words 'or equal,' so as to make some money on it?"

This temptation can be avoided if engineers draw up their specifications and under each class or division of the work incorporate the following paragraph:

"The contractor (or bidder) is required to give a basic bid on all materials, products and apparatus of the qualities and makes specified, and, in addition to the basic bid, the contractor is further requested to give alternate prices on other makes, which will, in his opinion, conform to the specifications, stating the additions or deductions involved in the furnishing of these alternate makes, and specifying the makes on which these alternates are based. Where no alternates are given in the bids, the makes specified must be furnished and installed."

An All-Metal Dirigible



Photos by courtesy of the Slate Aircraft Corporation

Fig. 1—An all-metal dirigible, being built in California, is to be driven by a steam turbine and radial blower mounted in the nose of the ship. Steam pressure is to be supplied from a 500-hp. flash boiler operating on a mixture of fuel oil and hydrogen gas. At 4,000 r.p.m., the blower is expected to take in air from the front and drive it away radially in sufficient quantity to drive the ship forward at 100 miles per hour

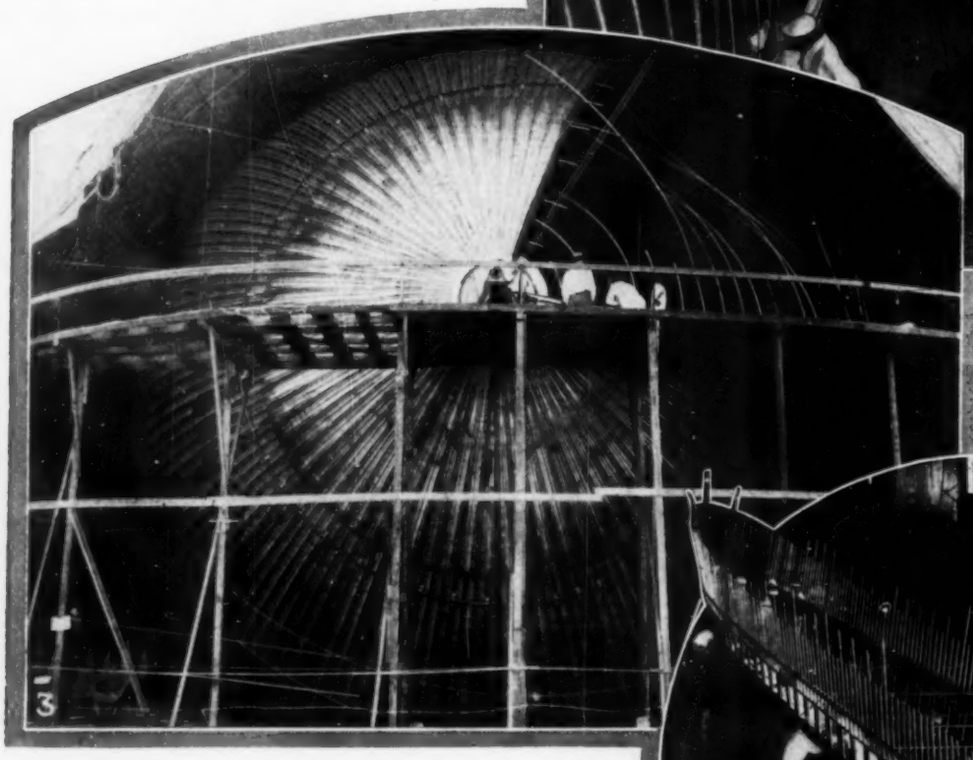


Fig. 2—The hull, which is 212 ft. long and 58½ ft. at its greatest diameter, is made of Duralumin. Strips of this metal in 200-ft. lengths by 15 in. in width are first lacquered and are then corrugated and riveted to ribs of rolled sheet Duralumin

Fig. 3—The longitudinal corrugated strips are secured to a circular ring at the front in which the turbine-driven blower is to be mounted

Fig. 4—The cabin is designed to accommodate 40 passengers and the crew. It is built of the same material and of the same general design as the hull, and is suspended from rods that extend through the hull to its top

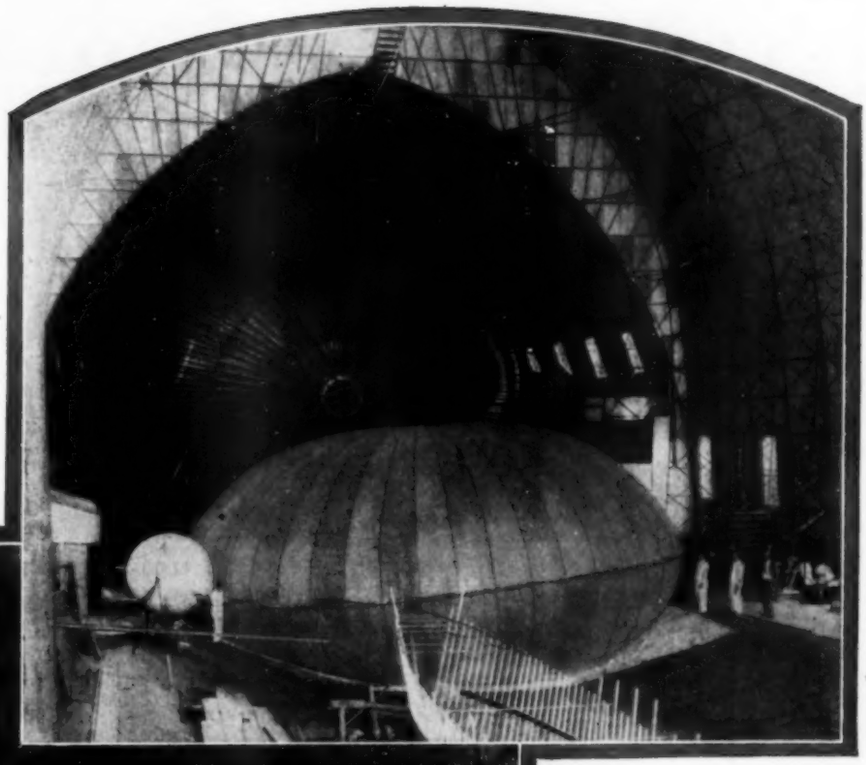


Fig. 5—A balloonet with 30,000 cu.ft. capacity is intended to compensate for expansion and contraction of the 300,000 cu.ft. of hydrogen gas in the main lifting part of the hull, giving a total gas volume of 330,000 cu.ft. The dead weight of the hull is approximately 7,000 lb., the same figure as that set for the expected capacity revenue load

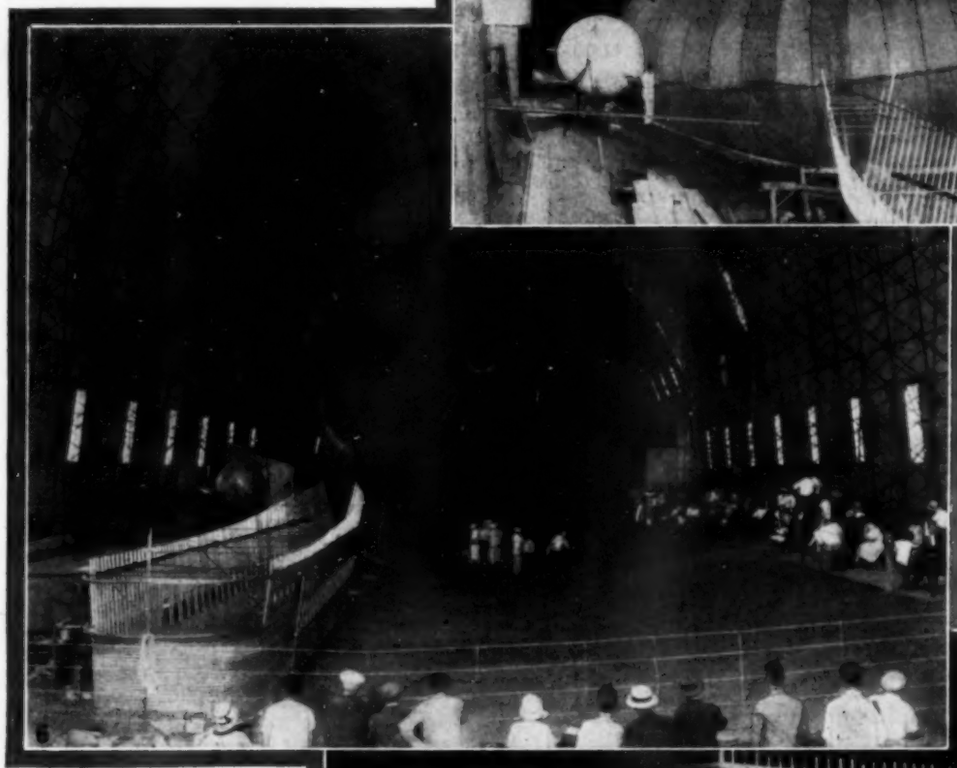


Fig. 7—Contrary to present practice of bringing lighter-than-air craft to the ground or of hitching to a mooring mast to take on or discharge passengers, this dirigible is also provided with an anchor and an elevator that will travel up and down the anchor line

Fig. 6—With hull and cabin completed so far as structure is concerned, the ship is brought out into an enlarged extension of the original hanger so the cabin can be secured in place. Up to this time, as can be seen, the power plant has not been placed in position

· THE · FOREMAN'S · ROUND · TABLE ·

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

The Man Who Shows Interest

"IT'S all right to want a man to be interested in his work, Al, but that new chap I hired the other day seems to want to know all about our shop."

"That doesn't sound so bad yet, Ed. What's the trouble?"

"No real trouble, but that fellow sure sticks his nose into every department whenever he gets a chance."

"If he doesn't stick to his job you can certainly remind him that he was hired to work in your department."

"Oh, he's on the job all right, Al, and a darn good worker too. But every noon after he eats he does a marathon all over the shop. Says he wants to know what we make in the other departments and to see where our work fits into the finished machine. I hope the men don't think he's a spy from some other shop trying to get on to our ways."

"Doesn't sound reasonable, Ed. If he was playing an underhanded game he wouldn't go around so openly. He'd be more apt to get transferred from one department to the other. And I can't see that we have anything to hide in the way of methods. We don't mind letting anyone see how we do the work."

"Well, why is he so interested, Al? It doesn't seem reasonable that it's all on the level."

"It's my guess that the lad is interested to learn all he can. And if he is, for the love of Pete don't discourage him. One of our great troubles is to get men who are interested in the job. It might not do any harm to talk with the boy and find out just what interests him."

"But why can't he stick to his own department? Why wander all over the lot and ask questions that don't concern him?"

"The more you tell me about the boy, the more I think I'd encourage him. Some shops make it a point to have a new man see the whole plant, if it isn't too big. Seems to me I'd ask him if he's seen this or that operation and take him around. You may even learn something yourself."

"That doesn't sound good to me at all, Al. I don't want to lug a new man around to other departments. And I'm not keen about having other men chasing through my section of the shop."

"I think you're a bit fussy, Ed. If this lad takes interest enough in the plant to spend his own time in getting familiar with it instead of reading the sporting page of the paper, he sounds good to me. That's the kind of a chap I'd keep my eye on to grow into an assistant some of these days."

"I might have known you'd take the other side," said Ed as they parted.

Is Ed right in wanting to keep the man in his own department? Or should he be encouraged to study the work of the whole shop as Al suggests? Is such interest likely to make a man more valuable?

All foremen are urged to discuss these questions vital to their work; of course the

discussion is not limited to foremen. Letters accepted and published will be paid for

Discussion of Earlier Topics

Shall a Man Sit Down to Work?

ED IS correct in saying that men cannot do good work sitting down, and I suggest that he allow them to sit down to only such work as cannot be done standing. Those jobs that can be done either way should be done standing.

A man standing feels more sure of himself and is less awkward and self-conscious. This is proved by the fact that if a superior approaches, the sitting man always endeavors to get up and usually does so awkwardly. But, whatever a man may do, it shows poor leadership to "bawl him out" in front of visitors.

—HENRI BORNSEN, *Hamburg, Germany.*

Instructors for Shop Men

THERE are human "misfits" in every line of endeavor. That being so, it follows that there are good, and not so good, machinists. Any scheme of instruction that will raise the level of workmanship and eliminate spoilage is worth trying. A "school" shop is rather questionable as far as cost is concerned and the majority of the men do not react favorably to the implication it conveys. One method of instruction which proved successful in the shop where I served my apprenticeship was as follows:

One of the men, with a good record of service and skill, was given the post of "tool-setter" with a slightly higher hourly rate. He got out all tools, fixtures and blue prints for the various jobs and saw that each man got started right. He thus left the foreman free for more important duties and was always at hand should any enlightenment be required by the less experienced hands.

—ROBERT S. ALEXANDER.

Spending Money for Oiling Equipment

A GOOD machine operator will always take an interest in the lubricating of his machine, especially if in his experience he has had trouble with machines through lack of oil. But good operators are few and far between, to prove this one has only to go to any second-hand machine dealer and inspect some of the machines of recent date which are for sale. You do not have to look far before you see the reason why some of these machines have been thrown out, examine the slides on the shapers; the beds and bearings of lathes; their scored condition tells its own tale. You think to yourself, surely an operator should be forced to oil such simple places on a machine as these but the mass of destruction which you see before you proves you are wrong. Therefore, Ed was mistaken in thinking he could save money by trusting the oiling of machines to their operators.

It is not surprising that Al was excited about the lubricating system on the new draw press, and this, with a special man to look after it was a great step in the right direction. But even this almost perfect system is not foolproof. Recently I was asked to inspect an automatic system of lubrication on a large steam engine and although there were two men in attendance to see to the oiling of the engine I had to report that the lubricators were not working as they had not been charged with oil.

—L. E. MARKEY.

Whistling in the Shop

THERE is always danger, if one has a "canary" in the shop, that he will, intentionally or otherwise, become at some time the leader of a group and set them all whistling. The average man will whistle or sing quietly to himself, get on with his job, and not interfere with those around him. His "warblings" will cease during his periods of concentration, such as setting up or re-tooling, and again a quiet whistle, more often than not, will bring relief when he is in trouble. If such a man does whistle, let him, and make him feel at home on his job. He will then respect his boss.

—A. M. GRIGG, *Foreman.*

The Exit Interview

INTERVIEWING men who have been discharged has its purpose, but it may be carried to extremes. The real purpose of such an interview is not to use it as a check on the foreman's ability to judge the character and workmanship of a man, but to reduce the turnover of shop labor. Everyone knows that it costs money to hire new men and acquaint them with the rules and methods, and when there is a continued turnover in any department, something must be done to find the cause and eliminate it. If the request for new men continues there must be something wrong with the job, and the exit interview affords a chance to find the trouble.

It may be that working conditions are not just what they should be, or that the job is monotonous. Whatever it may be the company can usually correct the cause by some slight change in shop regulations, or by transferring the man to another department as the case may call for.

—MORTON SCHWAM.

WITH a restricted source of supply and a scarcity of shop-trained men, the matter of labor turnover has become of prime importance to any industry. Following out this thought, it becomes fully as important to determine why employees leave, as it is to build up an efficient hiring organization.

A fair-sized percentage of replies from the departing employee, will be perfunctory and probably wide of the truth, but nevertheless, enough information will be

garnered by careful questioning to reveal any outstanding faults in the situation, as viewed from the worker's standpoint.

It is also true that under most conditions, a foreman will have sufficient knowledge of individuals under his supervision, and tact enough, to cope with any disturbing conditions, so that promiscuous quitting will be avoided; but, in the modern rush of high-production demands, all too many foremen, no matter how capable they may be, are forced to apply all of their energies to achieving output, to the neglect of even ordinary human contacts.

Under these circumstances, the intelligent checking up by an outside agency should be welcomed by the foreman, and viewed in the light of a co-operative service, rather than as a reflection against their personal ability or judgment. —D. C. WRIGHT.

ON THE man's record card there is usually a space for "reason for leaving," and as a rule this information is supplied by the foreman. Therefore, in justice to the man, he should be allowed to have his say before the employment manager; who will have charge of the record and may refer to it on some future occasion. But whatever the man has to say should be entered on the record and he should be asked to sign it, this in justice to the foreman. Some men on quitting are under the impression that they are not receiving fair treatment, and they will sometimes insist that they are being let out because other and less capable workmen, are friends or relatives of the foreman or that the foreman is trying to cover up errors of his own. Such accusations are best settled early and the employment manager is the best man to investigate the matter.

Some men when quitting will give any but the correct reason for leaving, especially if their complaint is against the foreman or his methods, and they will therefore put forward unsuitability of district or more suitable offer elsewhere. The same men would probably tell the truth to the right kind of employment manager who would then be in a position to help the foreman to understand changes for which he had been unable to account. —A. F. GUYLER.

IT MAY BE said for the employment manager's stunt, that the underlying idea which inspired it is an excellent one. It is good policy to seek by all legitimate means to retain the services of good and well-tried men. The question of what particular means shall be employed, however, is not always a simple matter, and it sometimes bristles with all sorts of practical difficulties. A former chief of mine, did his best for his subordinates, but when it came to choosing between loyalty to his men and his employers, rightly or wrongly, he invariably put company interest first. That illustrates in a way the sort of problem which at times arises and which has to be faced and solved.

One of the biggest assets of a manager is to have foremen who can be relied upon to act fairly and squarely, even against personal preferences and dislikes. When such is the case expedients such as that suggested are unnecessary. —W. R. NEEDHAM, *England*.

Al Orders an Emergency Pump

TO OBTAIN the replacement of an unsatisfactory component of a machine from the maker often costs more in the long run than to replace it oneself. The cost of delays in production, correspondence, arguing as to whether the part has been ill used or not, all cost much more than is at first realized.

There should be some definite arrangement as to authority for ordering material or machines, and if foremen are not to have this authority there should always be someone available to make such decisions and take the responsibility. No one should be indispensable to the extent that the system in operation causes production to be held up during his absence.

—H. JAMES, *England*.

* * * *

THE · NEXT · TOPIC

"Reporting Minor Accidents"

The Exit Interview

Summary of the Discussion

Ed thinks that having the employment manager interview each man who quits is of no benefit to anyone, and that it is somewhat of a reflection on the foreman. Al points out that the small shops in town have a much smaller labor turnover than their own, and attributes it to the fact that the "big boss" in the small ones has first hand knowledge of every man, and that they feel free to go to him with their troubles instead of quitting.

THE opinion is unanimous that the underlying principle of an exit interview is excellent, and that in practice it will be beneficial, if it is not used as a means of checking up the foreman.

One writer brings out the point that the average man will not always give the foreman his real reason for leaving. Another points out that labor turnover is expensive, and that any method that will help reduce it should be tried. Still another expresses a fear that it will be prejudicial to the foreman, because some men will welcome the opportunity to "knock" him.

Some shop executives outline other methods of arriving at the same result. One states that in his plant, a questionnaire concerning shop conditions, transportation, and personal satisfaction with their job, is sent to every employee periodically, and when returned the results are compiled and any outstanding trouble cured. Another one says that in his shop all quit slips are discussed at a round table at which the employment manager is present. Both these men believe that the method they describe makes the exit interview unnecessary. The concensus of opinion is that the exit interview is desirable, but that it should not degenerate into tale-bearing.

Operations on

Oil-Well Drilling Tools

Applying tungsten-carbide inserts to bitheads, and methods of grinding and heat-treating the finished tools

FOLLOWING machining, oil bits, as made by the H. C. Smith Manufacturing Company, of Los Nietos, Calif., are ready for welding. The first operation is the application of the tungsten carbide pieces to the cutting edges with an acetylene torch and a high-carbon welding rod. These pieces are placed in rows about ½ in. apart and staggered.

Tungsten carbide pieces, such as Borium, "Dimondite," "Hastellite" and "Titan," are furnished in the proper size, so that it is only necessary to weigh the correct portion for the size bit to be faced. The amount used is approximately 1 oz. to the inch of diameter, i.e., 9½ oz. for the 9⅝-in. bit, and 15 oz. for the 15-in. bit. A welding torch having a large orifice and adjusted with a flame having "ragged" edges, or an excess of acetylene, is preferred. First, the bit is warmed up to a red heat at the point where the inserts are to be mounted, then the tungsten carbide pieces are set in place. The flame is brought in contact with the work, so that the welding rod will flow over and under the inserts, thus completely surrounding them. After the inserts have been properly welded in place the entire cutting surface is covered with a hard facing of Stellite or Stoodite. This facing varies from ⅛ to $\frac{3}{16}$ in. in thickness, and is applied with an oxyacetylene torch.

A welding operator is shown building up a worn bit in Fig. 8. On the bench at the right may be seen examples of a worn bit and a similar tool that has been reconditioned ready for the application of a hard facing. The electric arc is used for building up the bit shown.

Blades of corebits that are ground by hand are not usually concentric, and therefore the cutting edges are not uniform in size and do not have the proper clearance angle. As a result they "walk around" in the hole, cutting oversize and reducing the size of the core removed. Another objection to hand-ground bits is that while they may appear correct in diameter, one blade may be longer than the other, resulting in less footage and greater wear due to chattering.

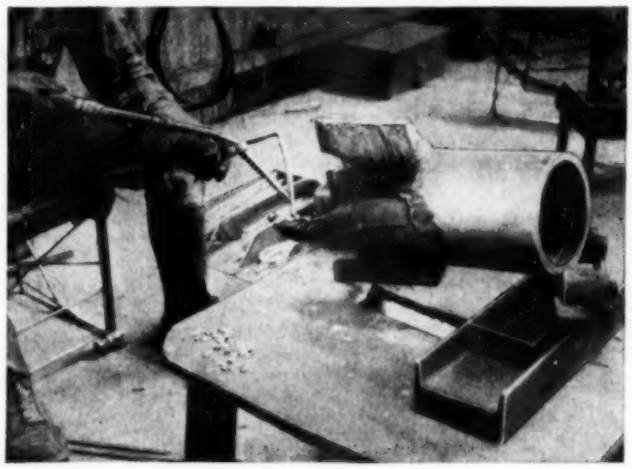


Fig. 7 — Applying a hard facing to a cast-steel drilling bit. Small pieces of tungsten carbide are placed along the cutting edges at staggered locations, and are then welded in place with a chromium welding rod. The work is preheated before the pieces are welded in place, so that proper cohesion of the materials will be assured

The conclusion of the article.

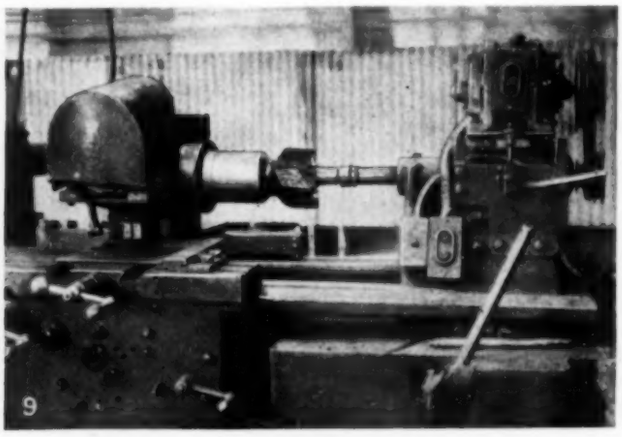


Fig. 8 — Rebuilding of worn tools is done by first building up the cutter body to its original proportions and then applying pieces of tungsten carbide and a hard facing. A comparison of a worn and rebuilt tool is shown at the right. Building up is done by the electric-arc process using a high-carbon rod. Fig. 9 — Grinding the bore of a corebit is necessary in order to avoid having the core choke in the mouth of the bit. A taper of 4 deg., with the larger end at the top, is provided to allow free passage of the core. The machine has an automatic transverse feed and permits inside and outside grinding at one setting

To overcome these difficulties, the grinder illustrated in Fig. 10 is used to finish the cutting edges. The set-up shows a bithead being finished on the outside diameter, but the machine is also adapted to internal grinding by swinging the work carriage 180 deg. and using the spindle shown at the right. In Fig. 9 is illustrated the machine set up for an internal operation.

As a final operation all drilling tools are heat-treated after being faced and ground, in order to remove any internal strains that may be set up during the welding operations. The furnace used for the purpose is electrically heated and controlled. The work is subjected to a temperature of approximately 1,400 deg. F., and is held at this temperature for a length of time suitable to its size. Following this operation the bits are ready to be placed in active service.

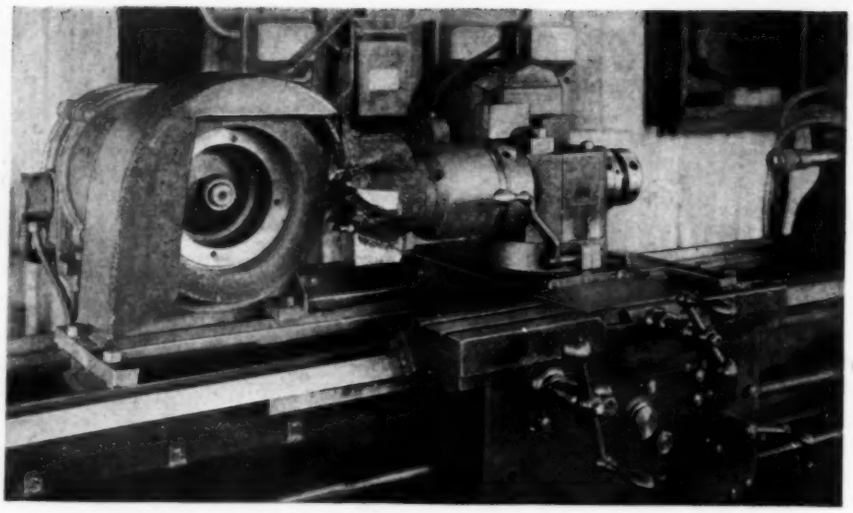


Fig. 10 — Grinding the outside diameter of a steel bit. A clearance angle of 8 deg. is given, in order to insure a proper cutting angle and adequate clearance. The work revolves as well as moving transversely across the face of the wheel

After drill bits are worn they are reconditioned in much the same manner. As shown in Fig. 8, they sometimes have very little resemblance to a cutting tool, when they come out of the hole. The reason for this is that it cannot be told that they have broken down for some time after it has actually occurred, consequently when brought to the surface they are in bad condition. The first step is to build them up to their original lines with high carbon rod, and then proceed to place the alloy cutting sections as in the case of a new head.

Inspectors for the Shop—Why Not for the Draftsman?

By J. A. Potter
Chief Draftsman, Singer Sewing Machine Company

THE article of Lucien Yeoman's on page 743, Vol. 70, of the *American Machinist*, while containing thoughts that may be ideal, will not work out in practice, as it eliminates the source of supply in that it does not provide for the making of future draftsmen. While a room full of experienced men may appeal to the chief as it would make his duties less arduous, the fact still remains that there are many jobs in a drafting room where lower priced men can be used to advantage.

The usual method in making a draftsman is to advance a youth through successive stages of blueprinting, print mailing to departments, filing drawings, making out cards, and odd jobs on the board such as detailing nuts, bolts, washers, etc., until he is able to make good tracings. After tracing he may develop into a machine detailer or may make a start at tool design on plug and snap gages, milling jaws, etc. At none of these stages would he be proficient enough to check his own drawings, and therefore the need of a more fully experienced man to check his work.

There is also the man to consider who has taken a correspondence course or one that has graduated from a trade school. First, the man must be made to realize that all drawings are to be actually used by the factory and not made just to give a credit to him of 80 per cent or 90 per cent. His drawings must be 100 per cent in so far as views and figures are concerned. Speed and quality will be acquired later.

It is possible to take a youth such as this (after explaining that the hardest part about trigonometry is in spelling the word) and in three months have him designing jaws, small tools and fixtures showing all details and the necessary figures, but of course these drawings should be checked.

Again take the fully experienced designer with ten or twenty years at the board, a man who is capable of filling in as a checker. This man would rather have his work checked by a second party since two developed minds are better than one. If required to check his own work, it will be far better for him to work on one or two other jobs before he starts to check, so that he can return to it with a clear mind and handle it in the same manner as a second party would.

A fast and accurate method to follow in tool design is to have the designer lay out his work on bond paper, making all details in pencil. This can readily be blueprinted, and makes a permanent record which can easily be altered if the part is changed. Details and assemblies of the plant product should, however, be traced on cloth.

Regarding the larger plants, employing 25 to 100 or more draftsmen, it is possible to operate such a department year after year with errors of only 2 to 5 per cent. This covers the designing of jigs, fixtures, small tools, special equipment, and the making of part drawings. This percentage is based on the final cost of tools, etc., plus department overhead against actual drawing cost. In other words, a formed cutter needs to be annealed and backed off due to an error on the drawing. The redrawing of the cutter, plus annealing, backing off, hardening, grinding and tool room overhead amount to $27. The $27 is charged to drawing room, whereas the original drawing shows a credit of only $1.75. From this it will be seen that two to five per cent is relatively a low amount for errors.

Welded Airplane Joints

A number of practical joints made of steel tubing and reinforcing plates, for the construction of fuselages and wing sections

WELDED-STEEL joints and fittings for airplanes are important, and require much attention in their construction because they distribute loads to adjoining assemblies. Their inability to withstand specified stresses may result in possible failure; therefore, extreme care is essential during welding.

Welding of steel tubing has characteristics involving a certain amount of technique, but this knowledge can soon be gained without great difficulty. All steels are affected to some extent during welding because an annealing operation, set up by the flame of the torch, decreases to a slight extent the strength of the original metal structure. The type of steel tubing usually applied to airplane assemblies, however, is only affected slightly if the weld is properly made. Nevertheless, if an excessive temperature is developed in making a weld, there is a possibility of setting up strains that will result in a weak joint, principally due to the burning out of excessive carbon which softens the tube structure.

Unequal welding, that is, the uneven distribution of the heat or the application of excessive heat, will cause strains that produce external distortion frequently resulting in a crack. Such defects develop after a weld has cooled sufficiently to permit the metal to resume its original shape.

When heat is applied to tubing an expansion takes place. The amount of expansion is quite important, and should be carefully calculated. Likewise, when a weld has been completed and the heat is allowed to dissipate, the result is that a certain amount of contraction takes place, which to some extent exceeds that of expansion. These differences should be analyzed carefully, because it is necessary to know the net changes as nearly as possible. An unequal proportion of expansion and contraction will often cause a buckle or develop an inward strain that may cause the joint to fail under service conditions.

Welding is done after both metal sections are heated and expanded, so that when they cool the welded joint has a tendency to offer a certain amount of resistance to contraction. This resistance is small, yet it is one of the factors necessary in constructing welded airplane assemblies, especially those made of steel tubing.

Welds should be made by applying an equal amount of heat at both sides of the joint or to both parts to be assembled, otherwise an uneven weld will result. The flame of the torch must be directed centrally to attain this condition, and the heat applied must be kept uniform. Welds are usually started after the sections to be jointed have been heated thoroughly, and have begun to melt slightly. The welding rod, which receives an equal amount of heat, is then brought in contact with the

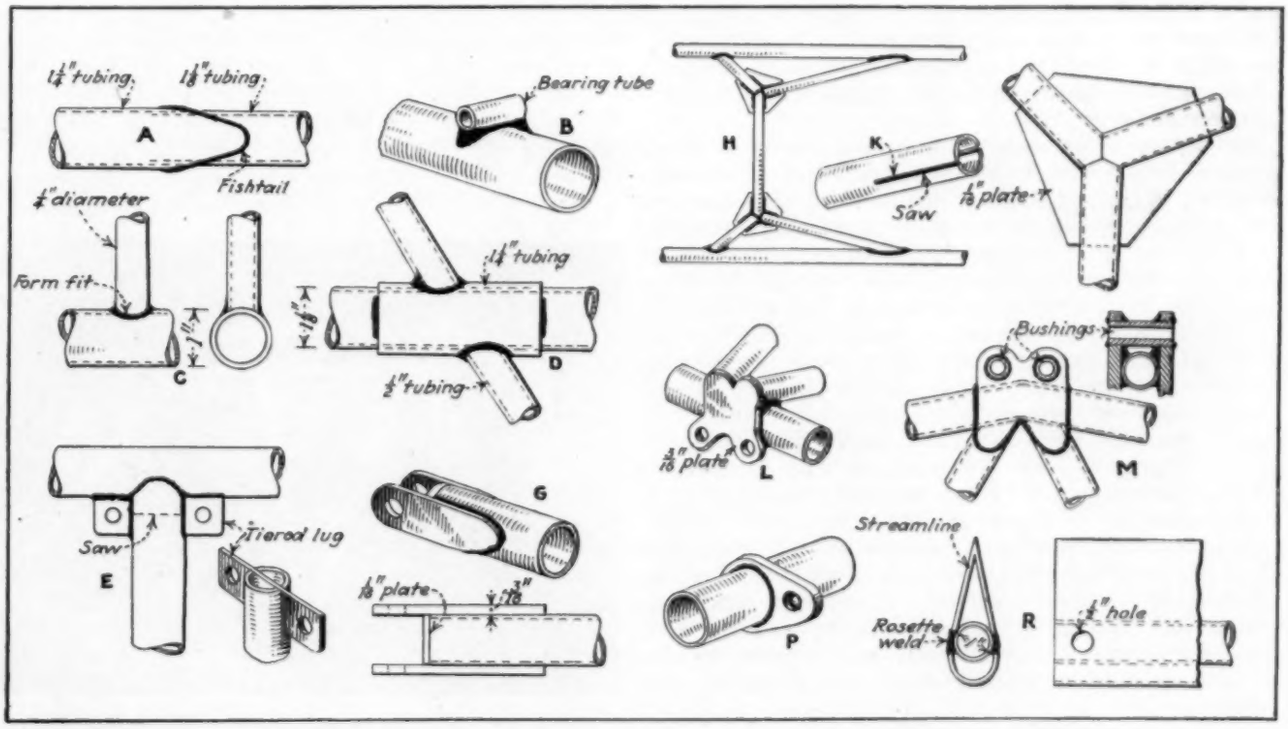
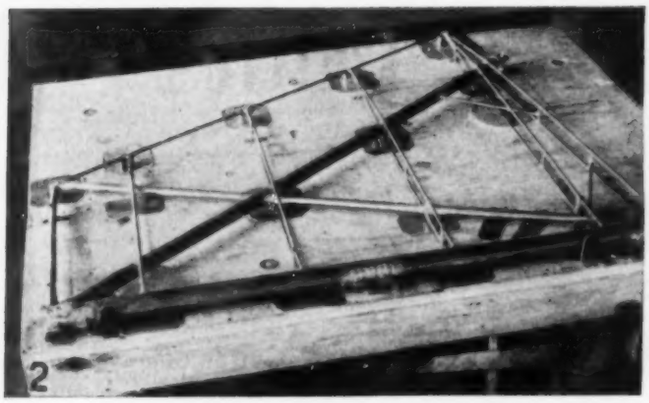


Fig. 1 — Welded joints for tubular airplane sections. Three important factors are required to produce well-made joints. These are: a uniform heat to avoid defective and warped sections, an even distribution of heat over the parts to be welded to reduce external strains, and a smooth finish. Reinforcing plates are made of chromium steel, and in some cases they are joined by cutting a slot in the tubing into which the plates fit



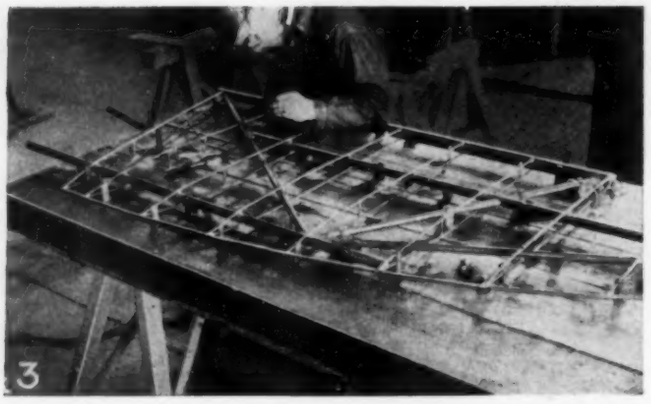


Fig. 2 — Due to structural changes that take place when heat is applied to tubing, it is difficult to finish welded assemblies in fixtures. These assemblies, therefore, are made in fixtures suited to tacking only. The fixture shown is for tack welding vertical stabilizer. Fig. 3 — A tack-welding fixture for a horizontal stabilizer. The various tube lengths are held in place by spring clips, then the joints are tack welded so that the wing assembly can be removed for finished welding of the various joints

flame enabling the joint to be built up to suit. Only a small section of the joint is welded at one time, so that excessive heat is prevented. Usually the thickness of the bead varies from $\frac{1}{16}$ to $\frac{1}{8}$ in., according to the proportions of the steel tubing.

Much depends upon the type of metal to be welded. A metal that will not corrode is preferred, and one less likely to be affected by moisture is to be favored. The welding of any metal, however, must be done so that no uneven surfaces or pockets will be left for moisture to settle in, because these pockets will result in excessive corrosion. Tubings having a small percentage of chromium have been found satisfactory.

These principles have been analyzed and are the factors that determine production methods of metal assemblies at the Stearman Aircraft Company at Wichita, Kans, in building its line of planes which include craft for commercial and sport purposes. Tubular metal assemblies are used for fuselages, landing gears, and tail surfaces, all of which are joined together by the oxy-acetylene welding process.

Before describing some of the joints, a brief description will be given of the welding equipment. Acetylene is received from a 1,000-lb. generator located in a separate building adjoining the main shop. The oxygen tanks, consisting of two series of 5 tanks each, are also located in the same building. This arrangement provides a surplus supply of oxygen to be maintained, and permits one series of tanks to be replaced while the other set is in use without any lost time. Both the oxygen and the acetylene lines are piped through the shop to the various points of use, having 13 outlets of the overhead type about 6 ft. above the floor. Each outlet is equipped with two sets of gages, so that 26 sets of torches can be applied. These connections are arranged to accommodate additional fittings when needed, which will increase this amount to 52 torch sets. The oxygen lines are painted green, and the acetylene red, to aid in checking any leaks or defects. Soap tests consisting of applying suds to the various joints are made at intervals of five weeks to avoid losses due to faulty fittings as well as from a standpoint of safety against fire hazards.

Several representative types of tubular welded joints are illustrated in Fig. 1. One of the main sections of an airplane is the fuselage, and many of the joints are for that assembly. The front end is subjected to a greater strain, and carries most of the load, and for that reason the tubing is telescoped from a large size at the engine mount to a smaller section at the tail end. For some fuselages, four sizes of tubing are used, namely, $1\frac{1}{4}$, $1\frac{1}{8}$, 1 and $\frac{7}{8}$ in. in diameter, all of which are of a suitable wall thickness to permit telescoping without additional machining. The joints are made with a double fishtail lap as shown at *A*, which gives about three times more holding surface than would be received by a square cut joint, thus increasing the strength.

Bearing tubes are joined to the fuselage tube as shown at *B*, although alignment is attained before welding by inserting a rod through the bearing-tube section on each side of the fuselage. The joint shown is for the brake pedal bar, and is made by building up the gap at each end of the bushing.

When an upright member is to be welded to a longitudinal section, whether they are of equal diameters or of different sizes, the fit is made by forming the connecting end of the upright member to suit the adjoining face. Such a joint is illustrated at *C*. Care is taken in making a well-fitted seat so that there will be no gaps to be filled by the welding rod.

In applying braces for such units as the shock absorber

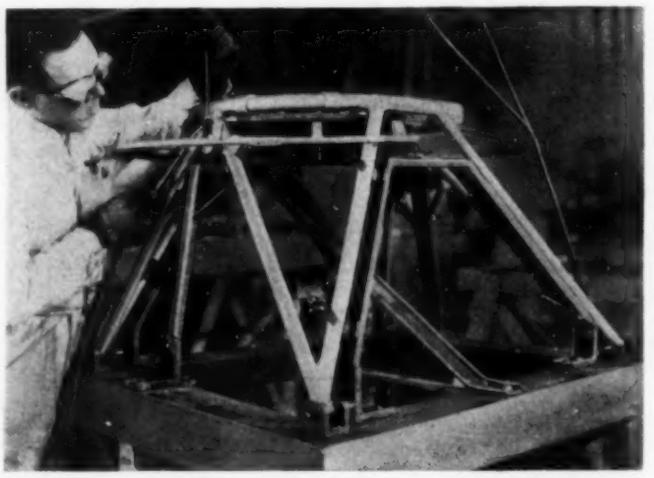


Fig. 4 — Welding an engine-mount assembly in a fixture that holds the V-members in relation to their position on the fuselage. After the joints have been tack-welded, the clamping pressure is released, then the joints are finish welded

and landing gear where a cross tube is mounted to one of the longerons of the fuselage, the construction illustrated at *D* is used. A sleeve is placed over the fuselage tube, and the cross members are welded to the sleeve. This procedure keeps most of the welding heat out of the longerons and, in addition, aids in making a stronger joint. After both sides of the joint have cooled, the sleeve is joined to the fuselage member at four places as outlined.

Tie-rod lugs are used extensively throughout the fuselage construction, and as a rule they are of the double type. In such cases they are made in one piece and fitted in place by sawing a slot of suitable size in the cross tubing into which they are placed. Then the cross tube is fitted to one of the longeron members and welded as shown at *E*. This form of construction is strong, and is comparatively easy to build.

Lugs for the engine mount are made as illustrated at G, by applying a $\frac{3}{16}$-in. chrome-steel plate on each side of the tubing. The connecting ends of the plates are made with a fishtail joint to gain additional strength and to reduce weight. The end of the tube is a $\frac{1}{16}$-in. disk welded to it to act as a seal against moisture. The disk has a $\frac{1}{8}$-in. hole at the center to allow the escape of welding gases. However, after the entire fuselage is completed a spray of linseed oil is injected in the small hole under air pressure, as a preventive against internal corrosion, after which the hole is seal welded.

Reinforcing Plates Are Chrome Steel

Most of the reinforcing plates welded in place are made of chrome steel to insure adequate strength, and at *H*, is shown a construction representing a cross-brace assembly located at the pilot-seat section of the fuselage. Five tube sections are joined together by two $\frac{1}{16}$-in. plates. The tubes are sawed through the center to receive the plate as at *K*, while at the right is shown an enlarged layout of the joint ready for welding. All faces are carefully fitted before the welds are started, in order to avoid having excessive strains set in.

Another form of reinforcing plate is shown at *L*, which is the construction used for one of the landing-gear connections. The side plate is formed to suit the location of the cross members, enabling a rigid assemply to be made. A somewhat similar construction, representing a landing-gear fitting, is illustrated at *M*, although in this case a plate is placed on each side of the longeron to allow the inclusion of two bushings through which assembly is attained. The design makes possible a strong joint which is required to take a proportionate amount of the landing load.

A popular form of tie-rod connection is shown at *P*, in which the fitting is welded around the entire surface of the tubular member to gain sufficient strength. The construction at *R* is a streamline section such as used in the landing-gear and shock-absorber assemblies. A tubing of suitable size is inserted into the streamline member, which in turn is secured by a number of rosette welds, made through $\frac{1}{2}$-in. holes as outlined. This form of section adds much strength to the streamline in contrast to the additional weight that results, with no increase in drag due to section.

Many other forms of joints are used, but they have similarities to those described. In the majority of the examples the practice is to leave the fuselage longerons intact, and to avoid drilling or other forms of joints that would tend to weaken the main tube sections. Carefully fitted joints are of paramount importance, and welding must specifically follow a standard form to insure uniformity, strength and reliability.

After the fuselage assembly has been completely welded an inspection is made of each joint and tube section for rigidity and alignment. If any misalignment is found it is straightened by applying a slight amount of heat at a corresponding section to correct the inaccuracy. However, perfection in constructing the necessary joints, chiefly uniform heats and welds, has reduced the number of fuselages requiring corrections to less than 10 per cent, and those requiring realignment are of a minor nature. This condition is largely due to the fuselage design incorporated, which provides for an equal amount of welding on each longeron, resulting in a so-called balanced heat application that equalizes net changes due to heat.

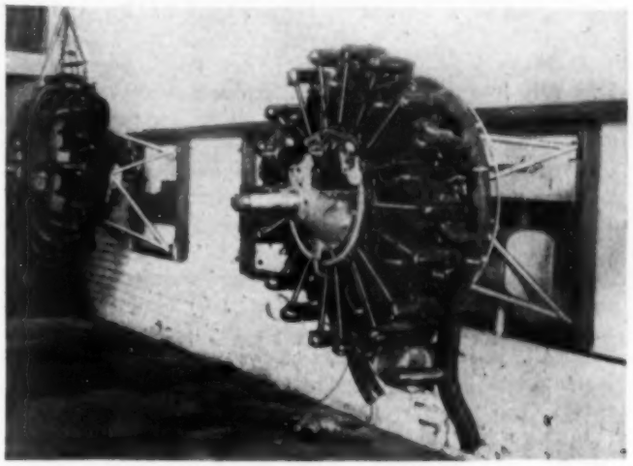


Fig. 5 — Motor mounts are set up on a wall rack, having connections resembling those of a fuselage. Then the unit is assembled completely, including the radial engine, oil tank, fittings and controls. The unit is made ready for assembly to the plane

The practice followed in welding assemblies that are comprised of several members is to provide an assembly fixture for locating the respective positions of the pieces needed and then tack welding these sections in place for removal. When the assembly has been joined in this manner it is taken out of the fixture and is finished by completing all the welded joints.

An assembly and tacking fixture for a vertical stabilizer is illustrated in Fig. 2. It is made of a hardwood base and has sheet-steel inserts located at points where tacking is to be done, primarily to avoid burning of the base by the welding flame.

Another fixture of similar construction is shown in Fig. 3, although it is for the horizontal stabilizer and is somewhat larger. Spring-type metal clamps hold and align the various sections to assure a correct assembly, then the tacking operation is completed. If an attempt were made to complete the welding in the fixture the metal changes due to heat, which are more prevalent on the smaller diameters, would cause a certain amount of difficulty, necessitating some form of complicated fixture that would compensate for these changes. Then, too, once the assembly has been tacked and removed from the fixture, the surfaces to be built up are more accessible than they would be in a fixture.

The same procedure is followed in assembling engine mounts and in Fig. 4 is shown the fixture applied. It permits location, alignment and clamping of the various

sections in proper relation to one another. The four V-sections are built up first, then the tubular headpiece, resembling a ring, is welded to the upper ends, and followed by the application of a circular exhaust-pipe support. All cutting and fitting is done before the pieces are clamped in the fixture, so that welding can be carried to completion when once started. The fixture is constructed of angle-iron sections, with supports made of light channel-iron braces. Welding is used extensively in its construction.

Engine mounts are inspected after welding, then coated with an oxide primer before further assembly. Prior to being installed in the fuselage, however, they are fitted with the motor and intermediate units as shown in Fig. 5. This method not only permits a check to be made of the general proportions of the engine mount, but also enables a test to be made under load, since the motor is mounted in a protruding position. The mount is fastened to a wall-type bracket that has connecting lugs corresponding to the fuselage specifications. When this work has been finished the assembled unit is removed from the bracket and is ready for use.

Are Premium Systems Covers for Indefinite Knowledge?

By Entropy

IF WE know the best way to do a piece of work it makes very little difference whether we pay for it by the day or piece. Getting work done under day-rates is a matter of insistence on speed and performance; getting it done under piece-rates is a matter of insistence on quality, plus the problem of persuading men that rates are not to be cut, which appears almost impossible. Premiums, bonuses, and other wage-incentives are admissions of ignorance. They say to the men, "We do not know how fast this work can be done, and done as well as it must be. Therefore we will divide with you the savings if it can be done faster than we suspect it can."

In the use of machine tools, as well as in their manufacture, we know very little about the possibilities of production. This statement will undoubtedly be challenged. Many experienced men think they know how best to perform various machine operations. There are some things that we do know. A simple job on a punch press fed from a strip of metal can be run at various speeds until the one speed at which the greatest production, consistent with the lift of the punch, percentage of spoiled pieces, and similar factors, is found. Then we know the best speed at which to punch them.

But we may be wrong in other details. Only the other day I ran across a shop where they were punching a pair of tapered pieces side by side from a strip of metal. They could have used a strip a quarter of an inch narrower if they had reversed one side of the dies and placed them closer together. They use this strip by the mile. Just how many years they had done it before a complete outsider saw the possible saving, I don't know.

For every job that has been studied and standardized, there are a hundred that have never been given consideration more than enough to get the work done somehow. For every job that is provided with holders for the work so that a chip proportional to the capacity of the miller or planer can be taken, there are a hundred, or maybe a thousand, where the workman builds up a cob house of various bolts, nuts, scrap iron and finished parts from other operations, until he has a tottering structure that looks like a futurist painting. There are a few shops that have studied their jobs and adopted methods of manufacture that utilize machines practically to full capacity, but most machines are never employed to remove the metal of which they are capable.

Most shops have to do the best they can with hit-or-miss methods because they have not the money to make exhaustive studies of the best ways to do their jobs. If a foreman is handling all the men he should, he cannot go onto the shop in his overalls to try out different methods, and neither can he spare his best men to do so. But there is a need for investigations into the best ways of performing operations under the conditions which obtain in small shops. For example take a small gear blank with a hub projecting from one side. If there are only twelve pieces and the job will not recur for six months it will not pay to rig up a turret lathe, and possibly the shop does not have one. It is naturally chucked, hand-reamed and turned on a mandrel. Since no one knows just how tight it is on the mandrel and the tables of co-efficients of friction do not help, the workman takes light chips so that the work will not slip. If he is 50 per cent efficient, he is doing remarkably well. If he is only 25 per cent efficient, who knows the difference? Of course, the right way to do the job is to buy a turret lathe, make 500 gears, and store the other 488 until needed.

A few shops have studied operations of this kind but what they have determined is specific and applies only to their own jobs and methods of doing work. What is needed is a sufficient number of experiments performed in a scientific way to enable fundamental rules to be laid down.

Someone will bob up and yell "time study," but my faith in the intelligence of fellow engineers is sufficient for me to believe that their time study is much like the scheme of the jeweler to whom we take a watch for repair. He always looks wise, with an eyeglass screwed into his eye, and says it needs cleaning. If we mention that it was cleaned a few days ago, but that we dropped it on the floor from an upper berth, he still reiterates that it needs cleaning. It is his only way to get rid of us so that he can take it to pieces and find out what ails it.

Just so, I suspect that time study has its greatest value in the fact that it lets the engineer into the shop with an apparent excuse for being there, so that he can give some real thought to methods. Time study or no time study, we do need to know the fundamental principles underlying the machine work that we have been doing by rule-of-thumb for the last hundred years. When we get this far, and when we can predict with some degree of certainty how long it should take a man to do a job that he never did before, we can put all our men on hourly rates, tell them when the job is to be done, tell them how to do it in that time and have to listen to very few excuses for failure to perform the task.

Lack of standardization in bushings for drill jigs has cost the automobile industry thousands of dollars, according to a well-known engineer of one of the large companies. Such losses are certainly preventable waste.

Nitriding Oil Tool Gages

By Frank W. Curtis
Western Editor, American Machinist

Nitriding of large thread gages eliminates a difficult grinding operation and produces a hard surface free from scale

ONE of the products of the Doheny Stone Drill Company is a tool joint made of alloy steel in a variety of sizes, such as that illustrated in Fig. 1. The thread is of modified Acme form and of the two-step helix type, so that it can be connected rapidly by dropping it half way into the box thread before rotation is started. The fit of the thread is on the major and minor diameters, namely the top and bottom of the thread, and the slow taper acts as a water seal for its full length as well as to take part of the driving stress. The hobbing is of extreme importance and accuracy is highly essential. Therefore, the problem of inspection is of primary consideration in order to maintain uniformity.

Since the thread is of unusual design, grinding of such a form would be difficult. For this reason, in making thread gages for the various sizes, both outside and inside, heat-treatment is done by the nitriding process because of the advantages made possible, namely, an extremely hard surface, non-oxidizing and practically no change in structure.

A diagram of the nitriding equipment is illustrated in Fig. 2, outlining the connections applied, and in Fig. 3 is shown the equipment as it appears out of the furnace. The electrically-operated "Homo" furnace automatically controlled, illustrated in Fig. 4, is used for nitriding. One of the completed gage sets may be seen in Fig. 5. Both sections were machined to finished size, with a total allowance of 0.0005 in. for permanent expansion, and after the heat-treatment the fit was within 0.0002 in. of accuracy, which is within the limits required.

Nitriding is done in a sealed chromium-alloy container, having ammonia inlet and outlet connections at the bottom and top of the container, respectively. This construction permits the ammonia gas to flow through all parts of the container, thus insuring thorough contact with all surfaces of the work. Frothing, and discoloration of the work is usually the result of a moist gas, therefore, the ammonia supply is filtered through jars containing calcium-chloride to remove any moisture that may be present. At the exhaust end of the container the outpassing gas passes through another jar of calcium chloride before passing through the water absorber.

The purpose of passing the exhaust through a drying medium is to avoid the possibility of moisture re-entering the container in the event the pressure of the gas flow became low.

With the work in the furnace chamber, the ammonia gas is applied and the heat is raised at the same time. Nitriding of gage parts is done at a temperature of from 950 to 1,000 deg. F. for a period of 24 hr. This temperature and length of time usually produces a case-hardness $\frac{1}{32}$ in. in depth.

The precautions to be used in nitriding parts are: To normalize the material prior to finish machining, so that there will be no internal strains; to remove all

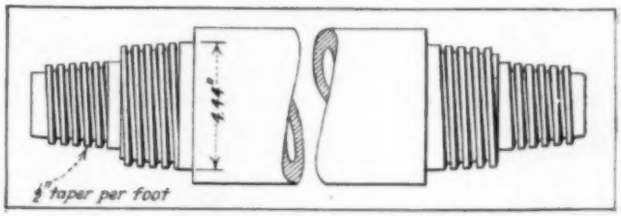


Fig. 1 — Tool joint for which the nitrided thread gages are used

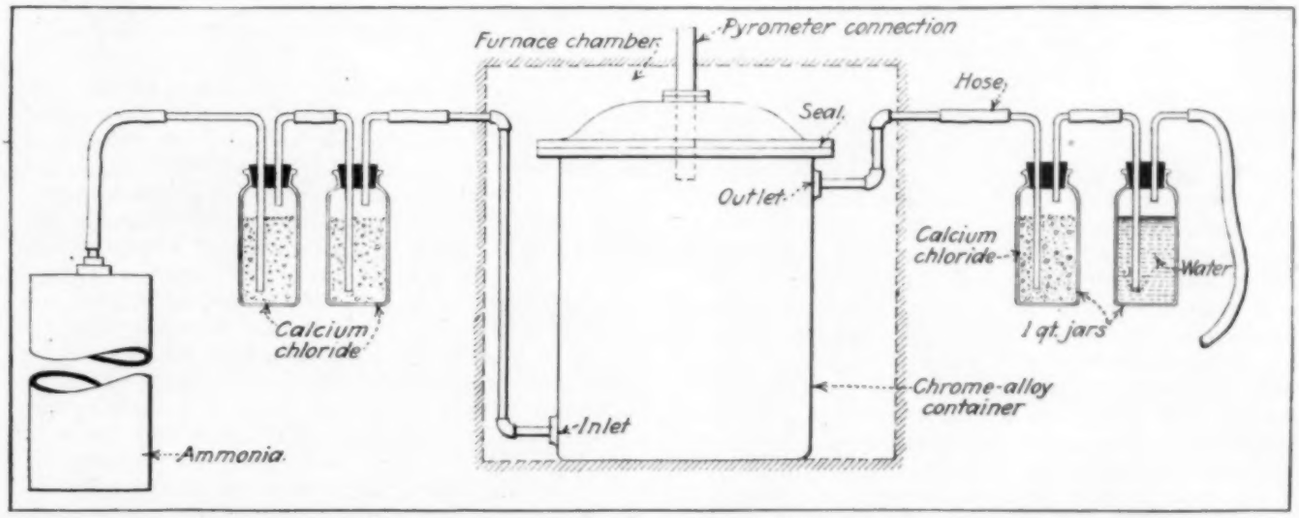
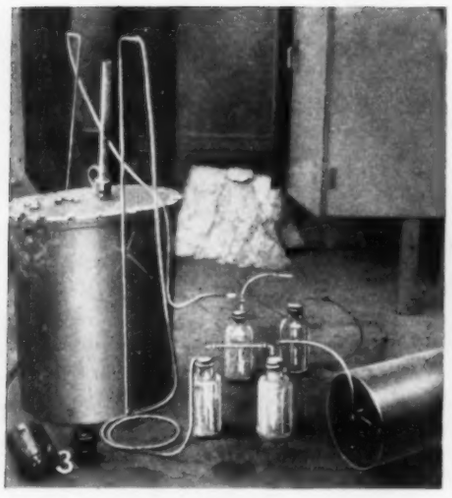
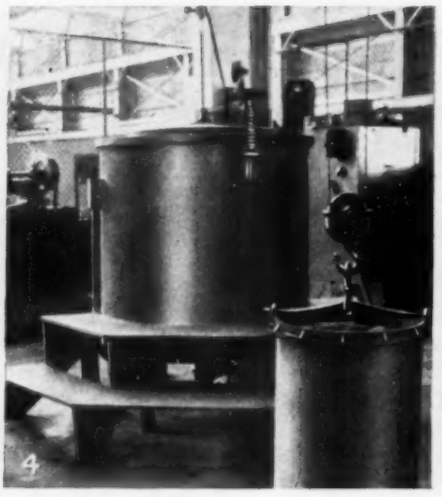


Fig. 2—A diagrammatic layout showing the method of connecting the equipment used for nitriding





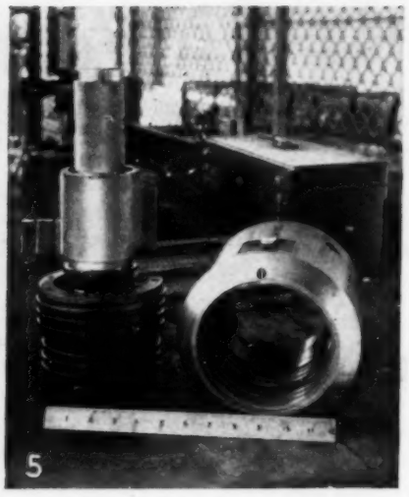


Fig. 3 — Equipment used for nitriding as it appears when removed from the furnace. The work is placed in a sealed container and is treated at a temperature of approximately 1,000 deg. F. with a constant flow of ammonia gas. Successful results are obtained only when the work is chemically clean and held at a uniform temperature during the process. Fig. 4 — For nitriding, the work is loaded and removed from the furnace by an overhead electric hoist. A two-step platform is built around the front section of the furnace to facilitate loading. Heats are automatically maintained and recorded. Fig. 5 — A set of thread gages hardened by nitriding. The surface of the work after treatment is extremely hard, free from scale and does not distort or change in size appreciably due to the treatment. An allowance of 0.0005 in. for permanent expansion is made before heating, and the finished part usually comes within 0.0002 in. of accuracy

grease, oil and washing compounds from the surfaces to be treated; to have all surfaces finished before treatment; to maintain a uniform heat throughout the treatment; and to be sure that a uniform flow of gas exists at all times. In this particular case 200 bubbles a minute through the ammonia absorber is the rate maintained.

After the work has remained in the heat for the designated length of time, the furnace is allowed to cool to a temperature of 500 deg. F. with a full flow of gas continuing through the steel container. When reaching this temperature, the gas is cut off and the outlet and inlet connections are sealed, after which the container is removed and allowed to cool to somewhat near the room temperature.

The material used for the gages is a chromium-aluminum steel which has been found to be satisfactory for the process, allowing nitrides to form with the grain and along the grain boundary.

Shop-Contact for the Draftsman

By W. R. Needham
Stafford, England

THE purely theoretical, office-trained draftsman is always at a disadvantage as compared with others who have had the benefit of a first-hand shop experience. Although there are not nearly as many non-shop-trained men now in England as was the case a generation ago, there are still many whose intimacy with the practical side of engineering leaves much to be desired. Just as a draftsman needs more than a course in machine drawing to give him real insight into the actualities of his craft, even narrowly interpreted, so the wisest and best vocational training in technical-school workshop practice cannot be more than a preparation for actual experience in the workshop of a commercial plant.

That policy which would forbid a draftsman the run of the works, is shortsighted and is setting a premium on inefficiency. The almost invariable result of such a policy is a leveling down until men who ought to grow into designers become little better than copyists. For their own benefit and the firm's also, men should seek to widen their outlook and their knowledge of practical matters. Every time their work takes them through one or other of the various shops, they should watch the machines, tools, and processes. So long as their questions are apropos, they should not be afraid to ask them. Most foremen are only too willing to help.

The Value of a Shop Library
Discussion

By R. L. Sirod
Newark-on-Trent, England

THE article by Joseph Viggiano on page 277, Vol. 70, of the *American Machinist*, on the above subject has some good points, not the least of which is the suggestion that the names of men who may be interested should be posted on the outside of books and magazines containing articles on work similar to that carried on by the firm.

If a supply of talent from the ranks is to be maintained, a shop library under the guidance of a competent literary advisor must become an indispensable part of every shop of any size. In my own work I have found that the average operator is eager to become better acquainted with his work, preferably through the medium of literature on the subject, but when he looks around him for any such literature he is confronted by a seemingly hopeless maze of books upon the subject, and he feels that it is hopeless to attempt mastering them.

It is at this time that the shop librarian becomes an asset and performs his real duties. Men should be encouraged to apply to the librarian in order that he may advise them what books and magazines to read, and what to avoid. The librarian should be carefully chosen. He should be sympathetic and understand men, for he will receive many strange requests, which should be answered with simplicity and understanding.

Present Status of Tungsten Carbide As a Cutting Material

By Frank C. Spencer

Assistant Superintendent of Machinery Procurement, Kearny Works, Western Electric Company

Report of the Subcommittee on Machinability of the A.S.M.E. Special Research Committee on Cutting of Metals, presented at the Rochester meeting of the Society, May 13-16

AT THE annual meeting of the Special Research Committee on the Cutting of Metals in December, 1928, the chairman requested the Sub-committee on Machinability to investigate the possibilities attendant upon the use of tungsten carbide as a cutting-tool material, and to make recommendations as to what action, if any, the Committee should take with respect to this material. The Sub-committee has made a preliminary survey by which it is sought to accomplish the following:

1. To list the various brands of this material which are or will be available and to learn something regarding the concerns which are producing them.

2. To ascertain the extent to which industry has adopted tungsten carbide for production purposes and the results which are being obtained by its use.

3. To determine the probable effect which the use of this material will have upon the future development of machine tools, and to make a recommendation as to what action this Special Research Committee should take with respect to such developments.

At the present time there are two tungsten-carbide products available in the United States, namely:

1. Carboloy—manufactured and sold by the Carboloy Company, of New York.

2. Widia—which is manufactured by the Krupp Company of Essen, Germany, and is imported by Thomas Prosser and Son, New York. The Wesson Sales Company, which has offices in Detroit and Chicago, is sales agent for Widia in Western territory.

In addition to Carboloy two other brands will be manufactured in this country, viz., Strauss Metal and Dimondite. Strauss metal is the trade name of the Ludlum Steel Company's product. This firm is now marketing tungsten carbide which is being manufactured for them by the Krupp Company, pending completion of its own plant which is scheduled for late spring. Dimondite is the trade name of the tungsten carbide which will be manufactured by the Firth-Sterling Company. This brand has not yet appeared on the market although it is being produced on an experimental scale and a comprehensive development program is under way. This alloy is also made under the same patents.

The demand for tungsten carbide in this country has grown with great rapidity owing to the inordinate amount of publicity which it has received. The supply of tungsten carbide available, however, has been confined until quite recently to that which could be secured from Germany.

Widia metal has been on the market since last fall, 1928, both in the form of rough tool bits and finished tools. There has been little difficulty in securing the former, but the production of the finished tools is limited owing to the fact that the operations of brazing the tips and of grinding and lapping the tools constitute a very specialized process, and one which requires experienced workmen to secure the best results. That seems to be the principal reason why this phase of the business has been slow in developing to a point where it can meet the current demand. That also is the reason why the demand for tungsten carbide has centered largely around the finished tools.

> The present status of the development of tungsten-carbide tools would not warrant radical changes in milling machines and drill presses, but it is safe to predict far-reaching changes in the design of lathes and similar machines. It is probable, however, that the development of the tools will proceed at a faster rate than that of machines

The Wesson Sales Company has on hand a stock of rough tips valued at around $400,000 to $500,000, based on the sales price. This firm has recently installed a large amount of equipment for producing finished tools and is making reasonably quick deliveries. Among the tool shapes produced are bits for turning, grooving, cutting off, milling, etc., drills, counterbores and formed cutters.

The Carboloy Company has only recently placed its product on the market. This firm does not furnish rough tips as it seems to prefer to retain control over the processes of welding the tips and of finishing the tools to the proper cutting angles. It has been making tools for some time, but apparently its entire output has been absorbed by the General Electric Company, either for experimental work or for actual production purposes. The output at the present time for the General Electric Company alone is reported to be around 6,000 tools per month.

The price of these brands seems to run uniformly at

$1 per gram, ($454 per lb.), which is the price stipulated in the General Electric-Krupp contracts.

A survey of the results obtained by several concerns in the Chicago and Detroit districts indicates forcibly the far-reaching effect which this material eventually will have on machining operations and substantiates in a general way the published claims of the manufacturers. The experiences of those users of tungsten carbide who were interviewed seem to be in universal agreement in one important respect; that is, that the life of the tungsten-carbide tools where they can be used, is many times greater than that of high-speed steel tools, even in the speed range where high-speed steel attains its maximum efficiency.

A large valve company has tooled an automatic chucking machine with tungsten-carbide tools, replacing high-speed steel tools for machining a bronze valve disk. The average life of the high-speed steel tools was 600-800 pieces per grind, while that of the carbide roughing tools was in the neighborhood of 27,000, the speeds, feeds, etc., being identical in each case. Incidentally, the high-speed steel used was the best obtainable. The part in question required a very good finish and for that reason it was considered advisable to continue to use a finishing operation. The tungsten-carbide finishing tools had produced about 28,000 parts at the time of our visit and were apparently as good as new.

Another manufacturer replaced high-speed steel tools with tungsten-carbide tools for machining a malleable-iron part having brass inserts. This operation likewise was performed on an automatic machine with no changes except the substitution of tools. The best tool life obtainable with high-speed steel was from 3 to 8 hours' operation per grind. The first set of tungsten-carbide tools ran for over six weeks before requiring regrinding.

These cases are of particular importance because in each instance an automatic machine was completely tooled and placed in operation on a production basis.

A large automobile company has obtained data on drilling Bakelite with a $\frac{9}{16}$-in. drill. The results indicate that on a strictly comparative basis tungsten-carbide tipped drills produced 10,700 holes per grind, the high-speed steel drills only 155. We have been informed that this corporation has several thousand dollars worth of tungsten-carbide tools in actual use for machining die castings, aluminum alloys, brass, bronze, cast iron, malleable iron, nickel steel and Bakelite. Most of the experiences observed relate to the application of tungsten carbide to jobs in which no changes were made in the machines or, at most, only the speeds increased.

A large clutch manufacturing company, found that by using tungsten-carbide tipped drills and counterbores for drilling and counterboring Bakelite-asbestos clutch plates they could secure in the neighborhood of 50,000 holes per grind as compared with a production of about 1,000 holes with high-speed steel drills.

It will be apparent that much of the tungsten carbide now in use has been placed in operation, first, in order to overcome machining difficulties and thus to decrease the "down time" which is ordinarily consumed by the frequent grinding of tools, and second, to obtain greater production by increasing cutting speeds where it has been possible to do so without danger of damaging the machines. Wherever the speeds were increased it was, of course, necessary to install larger motors to give the additional power required. However, on account of the limitations imposed by the machines available, it has in no case been possible to utilize the maximum benefits which could otherwise have been secured from the use of tungsten-carbide tools.

It is questionable whether tungsten carbide will ever be capable of withstanding heavier cuts than are now customarily taken with high-speed steel tools and it would seem, therefore, that whatever machine tool developments will be required on account of the introduction of this new material will be largely incidental to the increases in cutting speeds which it is generally agreed are possible.

Among the changes in machine tool design anticipated are: Larger bearings, greater rigidity, adequate chip disposal, ball-bearing tailstock centers, simplification of drive with fewer speed changes necessary, and in automatics, the lessening of time between operations. The problem of supplying coolant for the tools may be entirely eliminated

This committee feels that a great deal of development work must be done before machines can be designed with full confidence that they will be suited to the additional demands which will be thrown upon them. Assuming that the speeds are increased to the maximum which the tools can stand while maintaining the usual chip cross-sections, it will be apparent that a number of practical considerations must be taken into account, such as:

1. Bearing designs must be altered and additional rigidity provided throughout on account of the structural weakness of tungsten carbide. The cutting edges of tungsten carbide tools will break if appreciable chatter is permitted.
2. Chip disposal must be taken care of on a far larger scale.
3. Indications are that the problem of providing suitable coolant may be eliminated.
4. In automatic machines the mechanism controlling the action of the tools must function in the minimum of time in order that the greatest advantage may be derived from the new material.
5. It is quite reasonable to suppose that fewer changes in speeds will be be required and that there will be corresponding simplifications in spindle drives.
6. Lathe tailstock dead centers will not last with the cutting speeds which will be used and centers equipped with anti-friction bearings will be necessary.

There are at the present time certain definite machine-tool developments under way, having for their purpose the design of machines which will bring out the full possibilities of tungsten carbide. One well-known manufacturer of production boring machines has contracted to deliver several units which are guaranteed to stand up under the most severe conditions which may be encountered in the use of tungsten carbide. At least two manufacturers of special-purpose lathes have undertaken the development of machines which will make it possible to rough turn and rough groove Lynite pistons at speeds up to 1,000 ft. per minute.

The full import of these facts seems to be that certain machine-tool builders have fully realized the possibilities

of tungsten carbide and are endeavoring to take advantage of them as soon as possible. It is to be expected that any report covering this phase of the status of tungsten carbide will be out of date almost as soon as written. No doubt the machine-tool builders will fall in line very rapidly and redesign many of their production machines, particularly those for use in industries which are taking an active interest in this development. The machine-tool builders and the users will have to work this problem out together.

Some of the considerations which will have an important bearing on the question of how machine-tool developments will be affected by the introduction of tungsten-carbide tools have been mentioned. It remains to be seen to what extent the machine-tool industry as a whole will be involved in this development.

Production Machines Will Require Modification

It seems fairly certain that the whole bulk of the machine tools which fall in to the class termed production machines will eventually require design modifications in order to comply fully with the newer requirements. At the present time, however, the status of the dvelopment of tungsten-carbide tools would not warrant radical changes in the design of milling machines and drill presses, since neither milling cutters nor drills have so far been very successfully made up with tungsten-carbide cutting edges for use in machining high-carbon steel or alloy steel. As far as lathes and similar machines are concerned, it is safe to predict far-reaching developments on the basis of what has already been accomplished.

It is quite certain that further development of tungsten-carbide tools will proceed much faster than that of machine tools, and it would seem highly desirable, therefore, that the machine-tool builders undertake immediately a comprehensive study of all the factors involved in the adoption of the new tool material with a view to effecting the transition as economically as possible.

In November, 1928, the A.S.M.E. Main Research Committee, sensing the possibilities of tungsten carbide as a new cutting material, canvassed a large number of manufacturers and users of machine tools in this country for recommendations as to the part which the Society might play through its research organization in determining the changes in machine tools that will be necessary to adapt them to the use of the new cutting material. The consensus of the replies was that a research committee of the Society should be formed which could keep in touch with the development of tungsten-carbide cutting materials and publish information frequently for the benefit of all those interested. A representative cross-section of the views expressed may be had from those which follow.

In pointing out the need for a systematic development program E. F. DuBrul, said, "We can and ought to save all . . . intermediate steps. This can be done by a well-worked-out well-conducted research program, carried through by some neutral research agency, and financed by the producers of the cutting tools and the machine-tool industry, jointly."

Ralph E. Flanders felt that a thorough investigation should be instituted by the Society's Main Research Committee and that the co-operation of the National Machine Tool Builders' Association should be invited.

B. H. Blood expressed the opinion "that any proposed action of our Society should depend upon the attitude of the General Electric Company. If they would welcome the formation of such a Committee and cooperate with it, much might be accomplished. If they prefer to do their own research and maintain control of the results we would be at a great disadvantage. We would certainly have to rework much ground which they have already covered."

Evidently Mr. Blood had in mind research pertaining to the tools themselves. The Committee feels that for the present at least this matter should be left in the hands of the manufacturers.

Prof. O. W. Boston wrote, "It further appears that a committee should be organized to keep in touch at least with what is going on, perhaps encourage the publication of results of tests and practice, and to act as a clearing house for information as to the influence of this material on design of machine tools."

Professor Keller, suggested that, "The Committee cooperate with the National Machine Tool Builders' Association in urging the latter association to expend money for the purpose of research along the lines suggested by its secretary, Mr. DuBrul, in his November 9 bulletin."

This sub-committee agrees with Professor Keller and recommends that the A.S.M.E. Special Research Committee on Cutting of Metals urge the formation of a new committee by the Society's Main Research Committee, which shall have for its purpose the correlation of the activities of the various organizations which may be engaged in research connected with the development of machine tools to meet the newly arisen needs.

Petty Annoyances in the Shop

By H. Maplethorp
West Bromwich, England

THERE are many ways in which both effort and time, let alone patience and energy, are wasted in the average shop with inefficient tools. Perhaps one of the most annoying is a bad or defective vise. I was in a large engineering shop a short time ago where upwards of 3,000 employees were engaged and noticed that nearly all the vises were without either one or both their facing plates. Hence the gripping or holding power was almost nil, and in that state they were a source of danger to the workman. I have known of serious injury having been done by heavy castings falling out of a vise and landing on a man's feet. A good vise means "Safety First" in most cases.

There are many different types of vises upon the market that differ in their holding power to a very wide extent. To my mind, the parallel type comes first and therefore should be employed for all heavy work, as it holds the work in a more favorable position for filing. The leg vise is still used for many purposes and some people prefer them. Usually their steel faces are welded on to the jaws and are capable of being recut, but because of their construction do not come loose.

It will pay some engineers well to look to many of the small defects in their equipment even to the smallest item, such as the shortage of open-end wrenches. Badly-fitting wrenches are a nuisance and it is strange to say nearly every metal-working shop has a bad set of them. A lifting chain block is another item that will get out of order with constant use, and cause much waste of time and effort. These are only a few of the defects from which many workshops suffer, and it will well repay the manager to look round personally and examine these petty annoyances.

IDEAS · FROM · PRACTICAL · MEN

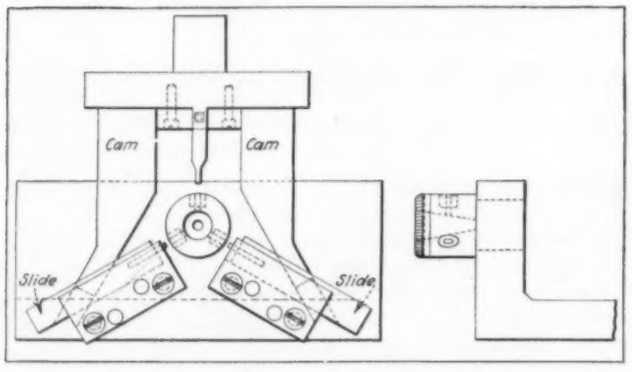
The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from a minimum of five dollars upwards, depending upon their merit.

Press Tools for Piercing Tubing

By Frank Browett
Triangle Tool and Die Company

About two years ago I designed and made the set of press tools shown in the illustration. The tools were for punching three $\frac{3}{16}$-in. holes near the ends of brass tubing. The holes were spaced 120 deg. apart and were all punched at one stroke of the press. The dies were inserted in a stake attached to the press bed by a bracket. Two of the punches were mounted on slides set at an angle of 30 deg. from the horizontal and were driven inward by cams attached to the press ram, as shown. The third punch was held in a punch holder attached to the ram in the usual manner.

Burrs left on the inside of the tubing from the cut-



Press tools for piercing tubing

ting-off operation made it difficult to place the pieces over the stake. This trouble was overcome by making a toothed ring, hardening it and mounting it on the end of the stake ahead of the dies. By placing the end of a tube against this ring and giving it a half-turn twist, the burrs were quickly removed, permitting the tube to be slid on the stake. These tools are still in use and have punched the holes in many thousands of tubes.

A Pair of Flush-Pin Gaging Fixtures

By A. Becker

In Fig. 1 is shown a gage for checking the location of the tooth spaces in a segment in relation to the beveled edge of another part. So that the tooth spaces could be started at the proper point, the fixture on which the segment was mounted in the gear cutter was provided with a locating pin in the same relative position as the one shown at *A* in the gaging fixture.

The gaging plunger has an enlarged head, so shaped as to enter any one of the tooth spaces and to bear against the teeth at the pitch line. The bearing in which the plunger is contained swivels about a shoulder screw,

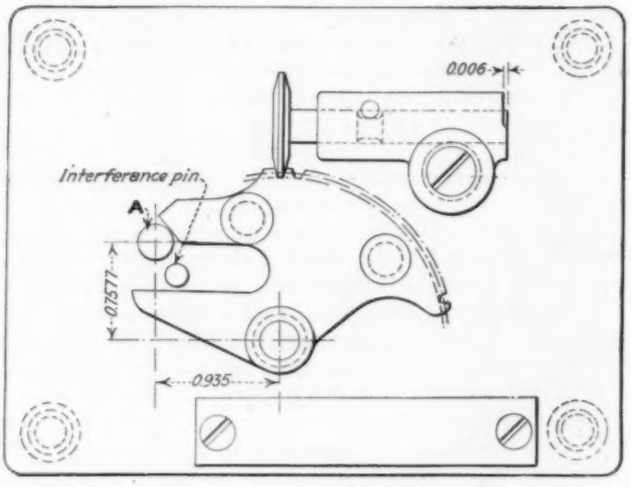


Fig. 1 — Gage for checking location for tooth spaces in a segment

and the rear end is stepped, the distance between the steps being 0.006 in., equal to a tolerance of ±0.003 in. If the tooth spaces have been properly positioned, when the segment is in the position shown and the head of the plunger is in the first tooth space, the opposite end of the plunger will be either flush with the one of the steps at the rear end of the bearing, or in between them.

A gage of similar construction is illustrated in Fig. 2. It is used for checking the angular relation between a

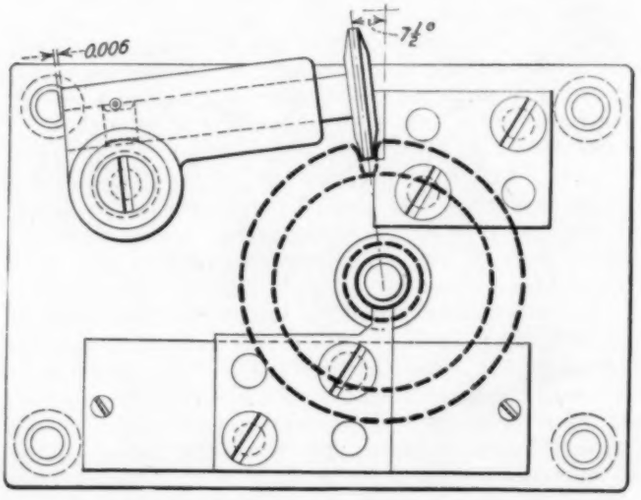


Fig. 2 — Gage for checking location for tooth space

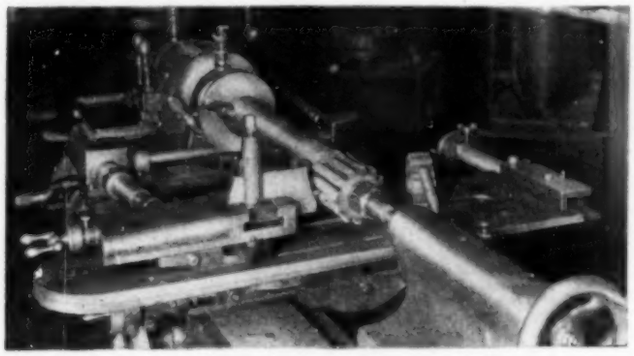
certain tooth space and the radial slots in the hub of a gear. The arrangement of the gaging plunger and the bearing in which it is contained is essentially the same as in the gage in Fig. 1, and the tolerance provided for by the steps at the rear end of the bearing is the same.

Lathe Attachment for Machining Concave and Convex Hobs

By R. B. Loveland

Some time ago it was found necessary to make several concave and convex hobs for cutting throttle-quadrants and latches. For this purpose the attachment shown in the illustration was made for use on one of our toolroom lathes. The attachment consists of two plates pivoted together at one end. The bottom plate has slots for attaching it to the toolblock in place of the compound rest. The top plate also has two slots for attaching and adjusting the compound rest, which carries the toolpost and the tool. The distance from the center of the pivot to the point of the tool is equal to the radii to be cut on the hobs.

The end of the top plate, opposite the pivot, is a segment of a wormwheel, while on the bottom plate is a



Radius attachment for a lathe

bearing carrying a worm. On the end of the worm shaft is a handwheel having a ring graduated to 5 sec. of arc. The graduated ring is provided with a clamp, so that in moving the tool from one tooth space to another, it can be set to zero and be rotated with the handwheel the proper number of graduations for the tooth spaces. There is also a clamp for locking the plates together after each setting.

As shown in the illustration, the attachment is set for cutting a concave, or quadrant, hob. By reversing the attachment so that the pivot will be at the rear of the lathe, makes it possible to cut a convex, or latch hob. In order to relieve the hobs, it is necessary to clamp a flat plate across the lathe shears, the plate carrying a shaft, bearings and miter gears for driving the relieving device through a shaft equipped with universal joints.

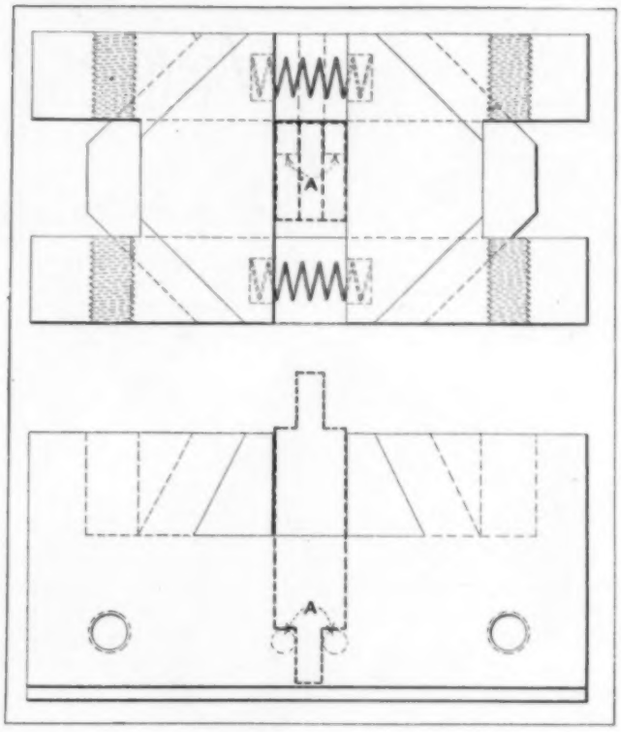
Centralizing Vise Jaws

By C. W. Hinman

The Addressograph Company

Having several hundred short, cast-iron pieces of rectangular section, both ends of which were to be straddle milled so as to leave tongues on them, we made the centralizing jaws for the milling-machine vise, as shown in the illustration.

Both of the vise jaws are cut away at angles of 45 deg. on each side of the center and are undercut, or dovetailed, at angles of 30 deg., as shown. The centralizing jaws are machined to fit these openings and are normally kept apart by light helical springs. The stationary jaw of the vise has the two pins *A* on its



Auxiliary vise jaws for centralizing the work

inner face, the distance between the pins being equal to the width of the tongues on the work.

In operation, as the movable jaw of the vise is advanced, the centralizing jaws are closed upon the work, clamping it in a central position widthwise of the vise, regardless of any variation in width. In milling the first end, the opposite end is rested on the pins on the inner face of the stationary jaw. In milling the second end, the tongue left by the first milling is placed between the pins, guiding the work so that milling the blank end will leave both tongues in line.

It will be seen that, while the thrust of the cut is taken by the stationary jaw of the vise, the movable jaw does not touch the work, all the clamping being done by the sidewise movement of the centralizing jaws.

Tools for Making Helical Bends

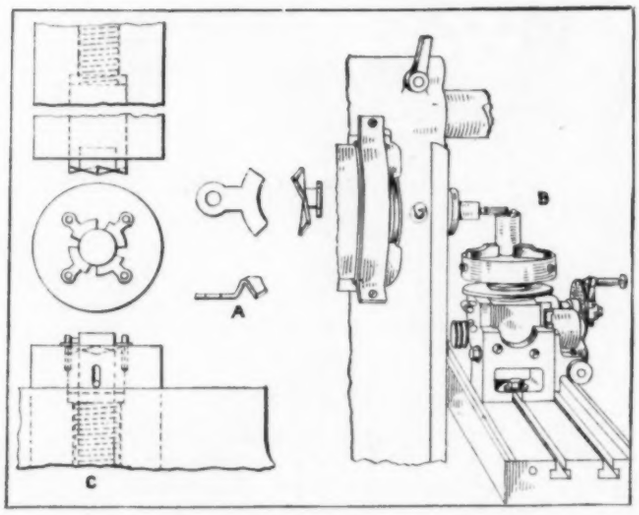
By A. Dana Seeds

Model Room, Corbin Cabinet Lock Company

A switch contact that had to be bent on helical lines of about 0.6 in. lead is shown at *A* in the illustration. The method of generating the helix on the tools is shown at *B*, while at *C* may be seen the tools themselves with four of the pieces in place.

As the circular segments of the pieces to be bent embraced but 74 deg. each, it was decided to make the tools to hold four pieces, all of which were to be bent at one stroke of the press. The pieces were located by pins and were grouped about a central plug in the die. Both the punch and the die are backed up by springs stiff enough to give but slightly as the bending takes place.

The helices on the tools were generated by holding them in a vertical position in the indexing head of a universal milling-machine, the cut being taken by a small end mill. The knee of the machine was raised until the cutter had cut into the work 0.0025 in. The



Tools for bending work on helical lines

work was then indexed 1½ deg., being cut as it rotated. At the completion of this indexing, the knee was again raised 0.0025 in. and the work was indexed another 1½ deg. This procedure was repeated until the work had been indexed for 90 deg. and had been cut to a depth of 0.150 in. at the last indexing. This cycle was repeated on each 90 deg. of the tools, the result being a four-start approximate helix having a lead of 0.6 inch.

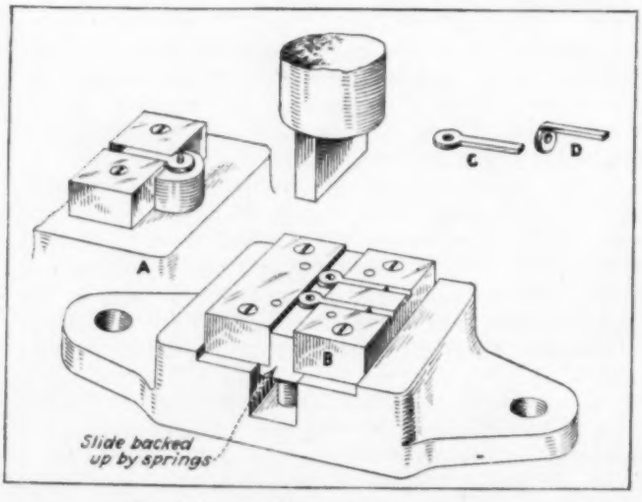
While the helices were approximately true only, the flat spots were so short (there being 240 of them in a complete revolution of the work) that they were almost negligible. Any deviation from continuity of lead was not noticeable in the product.

Tools for Bending Parts in Multiple

By Charles H. Willey

When our toolmakers were allowed to make simple dies for bending, without instructions as to design, they would nearly always make the locating of any piece having a hole in it a matter of putting it over a pin, as shown at *A*. While such dies were easily made and were generally arranged for bending but one piece at a time, they are slow in operation.

Our tool designer does not permit the making of dies of this kind when he knows that any considerable quantity of pieces are to be bent. In such cases the tools are made as shown at *B*. In these tools two pieces are bent at once, and instead of being located by pins, they are dropped into slots in such a way that the ends having holes in them come against the metal at the far side of the slots, as shown in the die *B*. Two pieces can be placed in the slots almost as quickly as one can be placed over the pin in the type of die shown at *A*. Not only can two pieces be bent at once in these tools, but they can be brushed, or blown, from the die after bending, not having to be picked off of a pin. A blank and a bent part are shown at *C* and *D*, respectively.



Tools for bending two parts at once

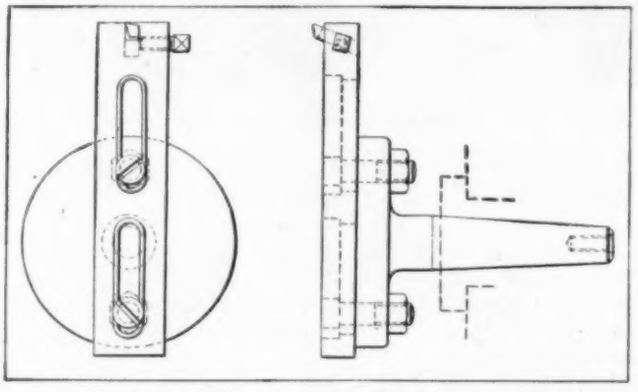
An Adjustable Fly-Cutter for Toolroom Work

By Ernest Foldvary

The manufacture of jigs and fixtures require square, flat and smooth surfaces. These must be secured either by machine or hand operations.

If the surfaces can be secured on a milling machine it is a decided advantage, because the succeeding operations can be done without changing the original set up.

The difficulty is that the pressure necessary to use a multi-tooth milling cutter is so great that chatter disturbs the accuracy of the piece being machined, and the surface is not left smooth, or accurate enough to act as a locating surface for the other operations.



An adjustable fly-cutter for toolroom work

This difficulty can be eliminated by using a fly-cutter, which, with its single point and different angle of rake for different materials, finishes the job in even less time than the milling cutter, if the job as a whole is considered. The saving of time, however, is not the main consideration in making tools, accuracy being the objective, and this is attained more readily by using a fly-cutter such as that shown in the illustration.

The old method of bending a piece of square steel and holding it in a shank by a set screw made a weak tool except on very small diameters. A permanent one was usually either too large or too small for the job. The one shown in the illustration is adjustable to suit any job within its extremes.

A shank fits in the spindle of the milling machine, and has a flange with two holes. The tool holder has a slot for the tool bit and two elongated holes for adjustment of the cutter. Both the flange and the tool holder can be dovetailed to give greater rigidity to the whole tool.

Engineering Materials Analyses

Marchant Automatic Electric Calculator

Analysis of the Marchant Automatic Electric Calculator shows a total of 1,177 parts and units per machine. Of this total, six units and 130 parts are purchased outside, and 1,046 are manufactured parts. The following breakdown study illustrates the importance of the parts and materials entering into the construction of machinery and similar equipment. The material cost is usually a large part of the total cost, making the bill of materials an item for the serious study of management. Of course, cost of material alone should not govern the selection of any one material over another. There is often the question of suitability, weight, strength, and workability. As a result of the balancing of these factors, we find five distinct classes of metals being use in this calculator.

Aluminum and Light Alloys

ALUMINUM DIE CASTINGS—13 parts, including side frames and base.

ALUMINUM SAND CASTINGS—5 parts, including side-frame members and base units.

Brass

ROD, ROUND AND HEXAGON—91 parts, including spacers, nuts and washers.

SHEET—55 parts, including miscellaneous shims and spacers.

CASTINGS—3 parts, including cranks.

Bronze

ROD, ROUND—22 parts, including bearings and bushings.

Iron

GRAY-IRON CASTINGS—10 parts, including side-frame members, center frames, base units and guide plates.

Steel

BRIGHT PUNCHING STEEL—365 parts, including balls, levers, disks, segments, braces, keys and latches.

COLD ROLLED, ROUND, HEXAGON AND SQUARE—404 parts, including studs, spacers, screws, rollers, nuts, bolts, shafts and gears.

NICKEL STEEL, SAE No. 3130—2 parts, including clutch-dog pins.

BESSEMER ROD—8 parts, including miscellaneous pins.

DRILL ROD—4 parts, including clutch driving pin.

NEEDLE BAR—58 parts, including dowels and shafts.

Miscellaneous

ADHESIVE PLASTER—3 parts, including linings.

PYRALIN—3 parts, including sight glasses.

Purchased Parts and Materials

CASTINGS—5 aluminum die castings, 1 brass die casting, 2 gray-iron castings.

MISCELLANEOUS—2 pieces of felt to pattern, 2 pieces of fiber to pattern, 4 Bakelite key tops, 25 celluloid composition dials, 84 celluloid composition key tops, standard iron and brass machine screws, Never-slip lock washers, taper pins, enamel and lacquer, 2 tungsten contact points, 2 name plates, 1 Decalcomania.

Purchased Units

One electric motor, 1 ¼-mfd. condenser, 1 switch cord, 1 electric motor switch, 1 cord connector, 1 attachment plug

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American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

Established 1877

The Value of Group Research

THE value of research to an industry is clearly exemplified in the work done by the National Advisory Committee of Aeronautics in its laboratory at Langley Field, Va. Here problems that affect the whole industry are studied from a scientific and engineering point of view, and much valuable information is secured, even if the entire problem is not solved immediately.

In order to secure the desired information it is frequently necessary to devise special instruments and methods, the cost of which might be more than individual concerns could afford. Large expenditures are frequently necessary, however, and when they are so made as to give adequate returns to the industry involved they are a good investment. In the aircraft industry much of the research is being done at Government expense through the Committee mentioned. This is due primarily to the direct part the industry plays in mail transport and in national defense. The results, however, are given freely to the whole industry, and they benefit the development of commercial air transport.

Research is playing a large part in many other industries, both by large corporations and by groups of industries, the entire group securing the benefit of discoveries and developments. Individual research inevitably means much duplication of effort that can be avoided when the work is carried on by a central body, which is a very potent reason for group research whenever it can be done. Trade associations have educated business men in the line of co-operative effort in some directions. Research is another line that may well be considered carefully from this point of view.

More Attention to Materials Handling

THE Department of Commerce is considering the formation of a new section to be known as the Material Handling Division. This move has been initiated because of the vast service which can be rendered to American industry through a central agency, of non-commercial character, to act as a clearing house for problems and information, and to encourage the development and application of the best in methods and equipment.

Since the advent of mass production, material handling has received growing recognition as a most important part of plant operation. While it is largely a service function, and, purely as a transport proposition, adds nothing to the value of the goods being made, nevertheless it cannot be dissociated from production.

Material handling has a tremendous economic significance. The dollars saved in production are frequently lost through inefficient handling. Over $100,000,000 is wasted annually in the mere loading and unloading of goods for transport, and much of this loss would otherwise become industrial profits. The wastes in connection with production are unmeasured. Hence the institution of the proposed Materials Handling Division, to co-operate with other agencies in this field of unlimited possibilities, marks another important step in the nation's industrial development.

Re-hiring Old Employees

THERE is one phase of the employment problem that is frequently overlooked in large plants—the re-hiring of men who have been laid off for any reason, not discharged for incompetency. In some instances the men are not considered as part of the institution and when men are needed to build up the force, a new man is as likely to be hired as one who has worked for the company previously.

Such a practice is thoroughly bad. It wastes whatever training the man may have received previously, because it takes a new man longer to fall into the routine than one who has worked under the prevailing shop conditions. Promiscuous hiring has another and more serious effect in preventing a feeling of loyalty toward the shop or company. And any plant whose men do not think of "our" shop, or do not feel that they "belong" to the institution, loses more than it thinks.

Then, too, the man who is not re-hired loses prestige at home; especially if some man from the same neighborhood is hired for the first time. The family naturally feels that there must be something lacking when "dad" is not taken back in the shop. And even though this may not result in nagging, it lowers the man's self respect and with it his usefulness to the shop, to the community, and to himself.

Unless the employment department manager recognizes the effect of such practices on the men, he is not the man to get the best results.

Reed-Prentice Nos. 2 and 3 Vertical Milling Machines

A NO. 2 "Becker" type die-sinking and vertical milling machine and a No. 3 Reed-Prentice ball-bearing die-sinking and vertical milling machine have been put on the market by the Reed-Prentice Corporation, Worcester, Mass. As shown in Figs. 1 and 2, these machines are driven by round canvas belting from constant-speed motors, but adjustable-speed motor drive can be had, or belt drive. Spindle speeds up to 6,000 r.p.m. can be obtained on the No. 2 unit and up to 4,000 r.p.m. on the No. 3 machine. The spindle of the No. 2 machine, as shown in Fig. 3, is provided with a quill construction for the drive pulley mounted on separate ball bearings so that the spindle is relieved of the belt pull. The idlers and lower cone pulley also run in ball bearings. The No. 3 unit also has a spindle equipped with radial and thrust ball bearings.

Column and knee of the No. 2 model are sturdily built and are of full box section for rigidity. The main castings contain a high percentage of steel. A saddle extending the full length of the table, as in all Becker machines, forms a rigid support for it. This saddle is gibbed to the knee and the table is gibbed to the saddle. Cross, vertical, and longitudinal feed screws are provided with micrometer collars for accurate control, and all screws are supplied with ball thrust bearings, insuring ease of operation. Accurate control of the cutter is provided by the sliding head which is operated by a treadle or clutch-type handle at the right-hand side of the column. A micrometer stop is furnished.

Specifications of the No. 2 Becker miller are as follows: Longitudinal feed, 14 in.; cross feed, 11 in.; vertical feed of knee, 15 in.; head travel, 2 in.; maximum distance between spindle and machine table, 17 in.; maximum distance between spindle and rotary table, 13 in.; maximum distance between spindle and frame, 15 in.; working surface of machine table, 18x8⅞ in.; working surface of rotary table, 15 in.; floor space, 54x57 in., and weight without rotary table, 1,775 lb. Extra attachments include the rotary table, collets from ⅛ to ½ in., a blower attachment for

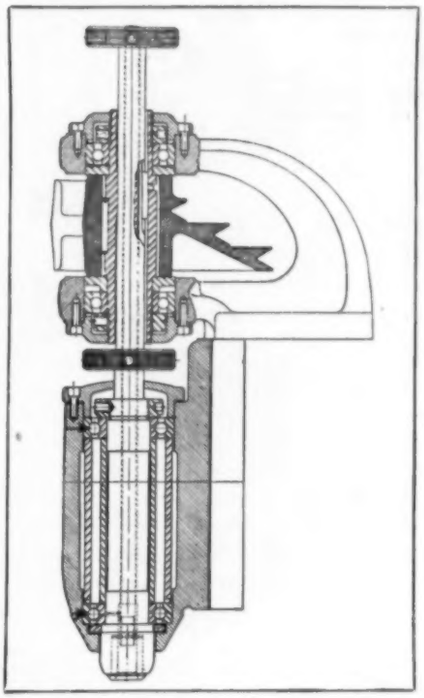
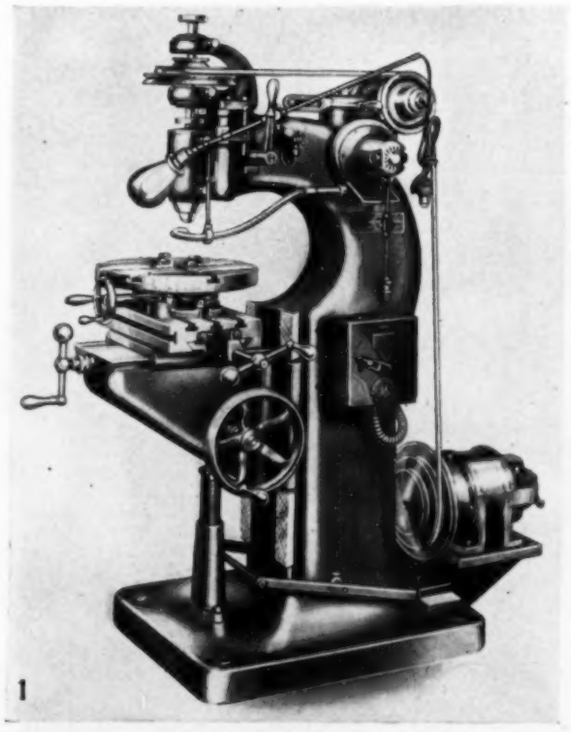


Fig. 3—Spindle construction of the Becker No. 2 Vertical Milling Machine



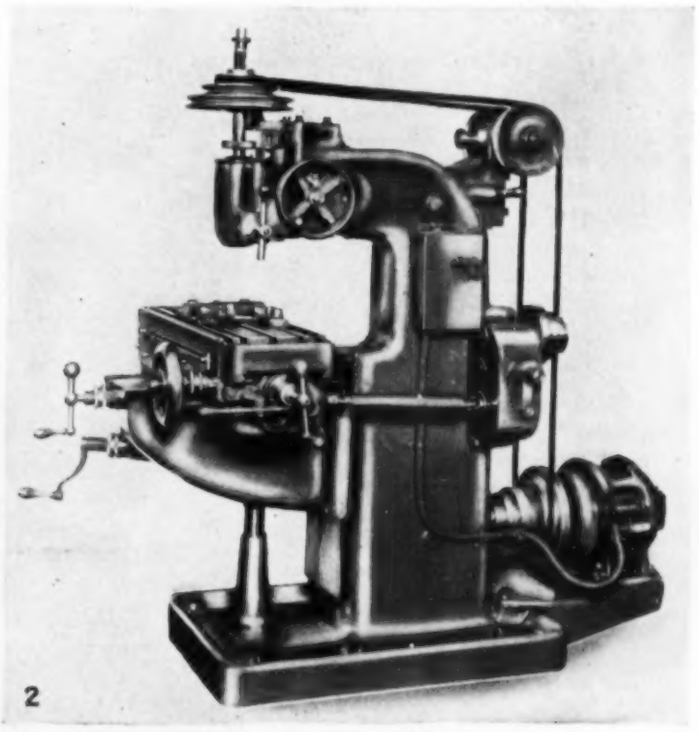


Fig. 1—Reed-Prentice No. 2 "Becker" Type Router and Vertical Miller having constant-speed motor drive
Fig. 2—Reed-Prentice No. 3 Die Sinking and Vertical Milling Machine with constant-speed motor drive

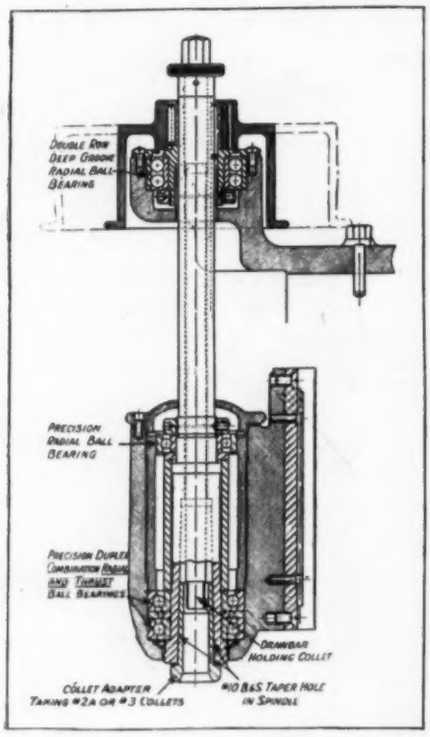

DOUBLE ROW DEEP GROOVE RADIAL BALL BEARING
PRECISION RADIAL BALL BEARING
PRECISION DUREX COMBINATION RADIAL AND THRUST BALL BEARINGS
DRAWBAR HOLDING COLLET
COLLET ADAPTER TAKING #2A OR #3 COLLETS
#10 B&S TAPER HOLE IN SPINDLE

Fig. 4—Spindle construction of the Reed-Prentice No. 3 Vertical Milling Machine

clearing chips at the cutter point, and an adjustable lamp bracket.

The constant-speed motor drive, which can be supplied on the No. 2 unit, gives spindle speeds from 1,350 to 5,300 r.p.m. A 1-hp. motor is recommended. Adjustable-speed motor drive can also be obtained with speeds ranging from 500 to 1,500 r.p.m., giving spindle speeds from 1,200 to 6,000 rev. per minute.

Construction of the Model 3 die sinking vertical milling machine permits the use of a tool satisfactory for engraving, light die sinking, toolroom work, and general manufacturing purposes. The knee is of the rigid full box form and minimizes vibration. The sliding chip guard in the front of the carriage protects the cross-feed screw, and also enables the machine to be more freely cleaned of chips. Spindle speeds to meet average conditions are furnished through 5½- and 10-in. spindle drive pulleys. Proper belt tension is secured by adjustment of removable idler pulley bracket.

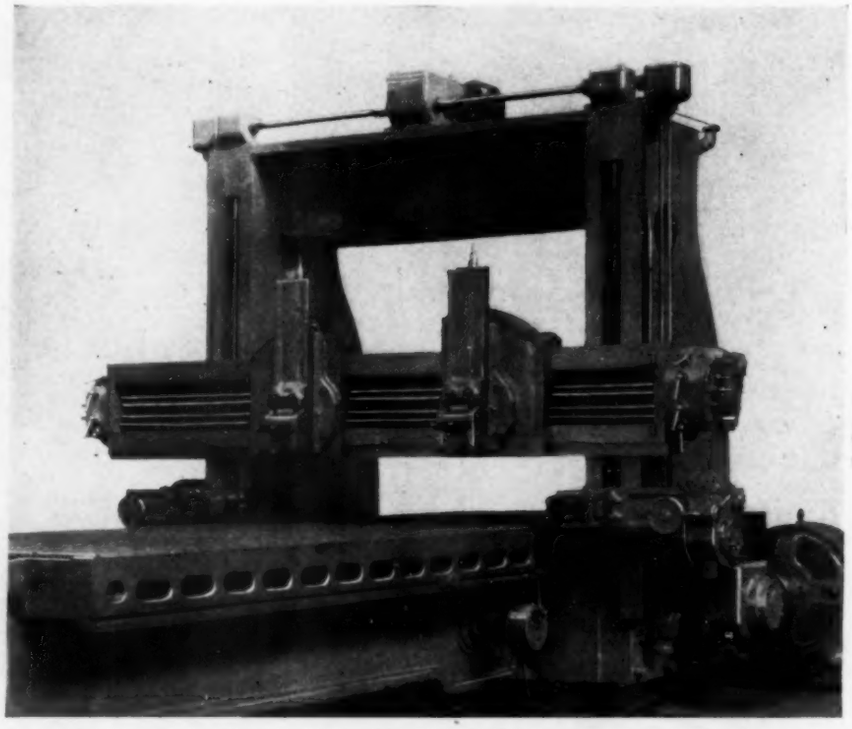
The carriage has a wide center bearing on the knee, and supports the table for its entire working surface. Both longitudinal and cross-feed screws are arranged with micrometer dials and ball thrust bearings, while the knee is raised and lowered by means of a telescoping screw. The power longitudinal feed to the table is obtained through feed cone pulleys and a sliding gearbox, which has hardened steel gears. The machine has six different feeds. A rotary attachment with power feed adds to the range of work the machine is capable of doing, and can be applied extra. It is equipped with both hand and power feed, and has an oil pan graduated to 360 degrees.

Specifications of the No. 3 unit are as follows: Longitudinal feed by power, 21 in.; cross feed, 12 in.; vertical feed of knee, 17 in.; head travel, 3½ in.; maximum distance between spindle and table, 16½ in.; maximum distance between spindle and rotary table, 12 in.; maximum distance between spindle and frame, 16 in.; rotary table working surface, 13 in.; machine table working surface, 10¼x30¾ in.; spindle speeds range from 95 to 1,225 r.p.m.; floor space 73x68 in.; weight, without rotary table, 2,400 lb. Constant-speed or adjustable-speed motor drive can also be obtained for this model.

Cincinnati 96 x 96-Inch "Hypro" Planer

ALL the standard features of the concern's line have been embodied in the 96x96-in. "Hypro" planer announced by the Cincinnati Planer Company, Cincinnati, Ohio. A harp clamp has been added to the saddles which eliminates any possibility of the harp pulling away when the slide and tools are extended below the bottom of the rail. A narrow guide has been added to the saddles on this machine to prevent springing. Electric rail clamps of a sturdy design have also been supplied. A small torque motor is placed inside of the rail and a self-contained unit operates the two clamps on the inside. A push button disengages or engages automatically the power clutch and then releases the clamps. With this interlock it is impossible to raise and lower the rail while the rail is clamped.

The standard tumbler mechanism has been simplified, eliminating all shafts and other details and connecting it directly to the master switch. A parallel drive box has been placed on the right-hand side of the housing. This box contains two hardened chrome-nickel spiral bevel gears running in 600 W lubricant and all the shafts are mounted on ball bearings. By this addition the floor space usually taken up by the motor is saved



Cincinnati 96x96-Inch "Hypro" Planer

Brown & Sharpe No. 4A Universal and No. 4B Plain "Standard" Milling Machines

REGULAR constructional and operating features of the line of "Standard" milling machine previously described on page 35, Vol. 68, and page 369, Vol. 69, of the *American Machinist* are available in these largest of the "Standard" machines, the No. 4A universal and the No. 4B plain millers, made by the Brown & Sharpe Manufacturing Company, Providence, R. I.

The machines are all gear driven, with anti-friction bearings from driving pulley to spindle and in the feed and power fast travel mechanisms. Two operating positions are provided, one at the front and one at the rear of the table, with all levers controlling the operation of the machine readily available from either position. Dual control for feed changes (a lever at the front of the table and one at the rear) facilitates feed changes being conveniently accomplished. Speed changes in two series are made by a single lever at the side of the machine. The rates of feed and speed for which the machine is set are indicated by direct-reading dials located above the control levers. The machines are equipped with power fast travel for longitudinal, transverse and vertical movements, operated by handy levers.

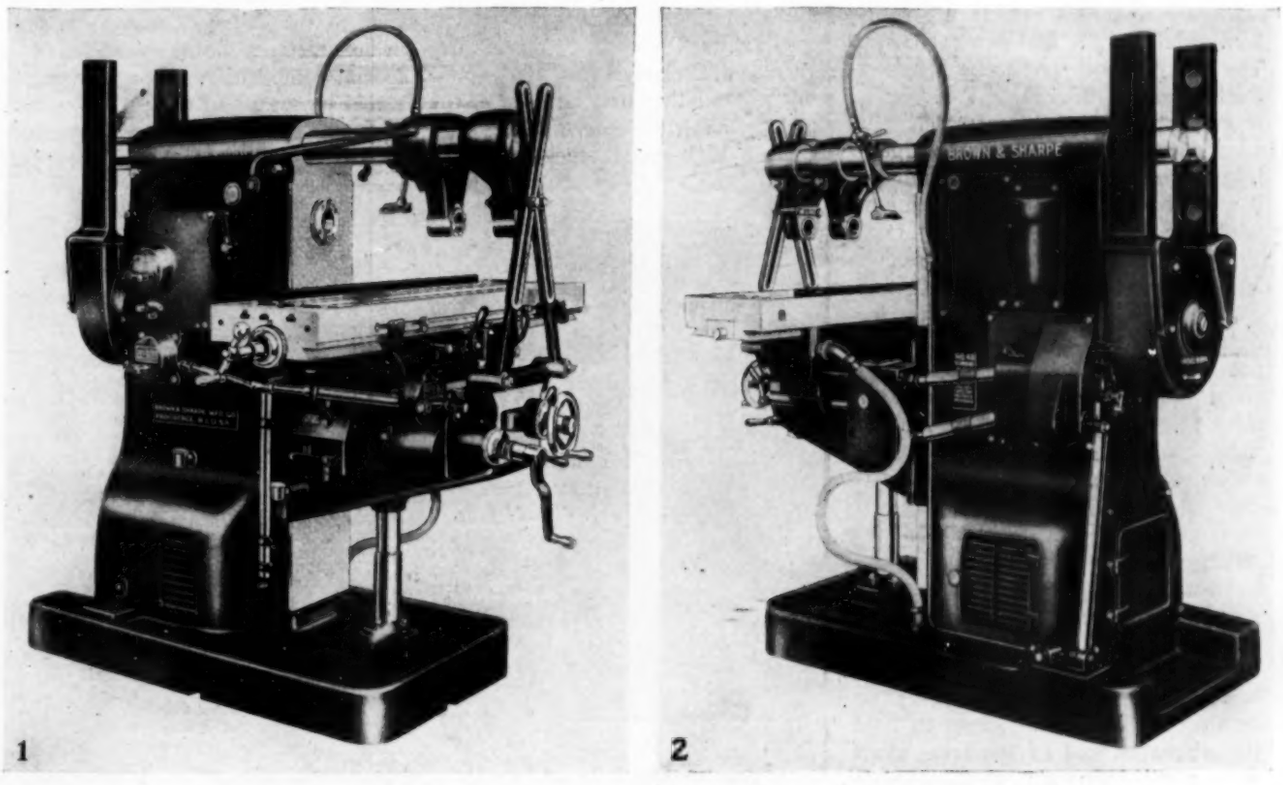
One of the important features of the No. 4B Standard plain milling machine is the automatic disengagement of the power fast travel with simultaneous engagement of the cutting feed without any attention on the part of the operator. This feature makes possible a considerable saving in operator's time, as the work can be run up to a point close to the cutters before the cutting feed is engaged. It also prevents injury to the work and cutters through accidentally jamming the work into the cutters. The operator is free, after the fast travel is engaged, until the cut is completed, during which time he may be engaged in operating another machine.

Automatic lubrication with filtered oil is provided for all mechanisms within the column and for the driving pulley of each machine. Automatic oiling is also provided for the knee assembly, a separate pump being installed in the knee for this purpose. A single oil well lubricates the saddle and table bearings. The knee elevating screw is one piece, does not extend below the base of the machine and is completely guarded in all positions.

The machines are available either as belt drive, fitted for motor or equipped with motor. When motor driven, the motor is located in a ventilated compartment in the base and drives the machine by chain and sprockets. It is mounted in such a manner as to be rigidly held in place yet readily accessible. Adjustment of the tension in the driving chain is by an adjusting screw located outside the motor compartment. The entire drive, either by motor or by belt, is adequately guarded.

Trahern Fireproof Hand-Transfer Pump

A hand-transfer pump, which is vapor-proof, fireproof and explosion-proof, is being manufactured by the George D. Roper Corporation, Rock-



Front and rear views of the Brown & Sharpe No. 4B Plain "Standard" Milling Machine

Trahern Fireproof Hand-Transfer Pump

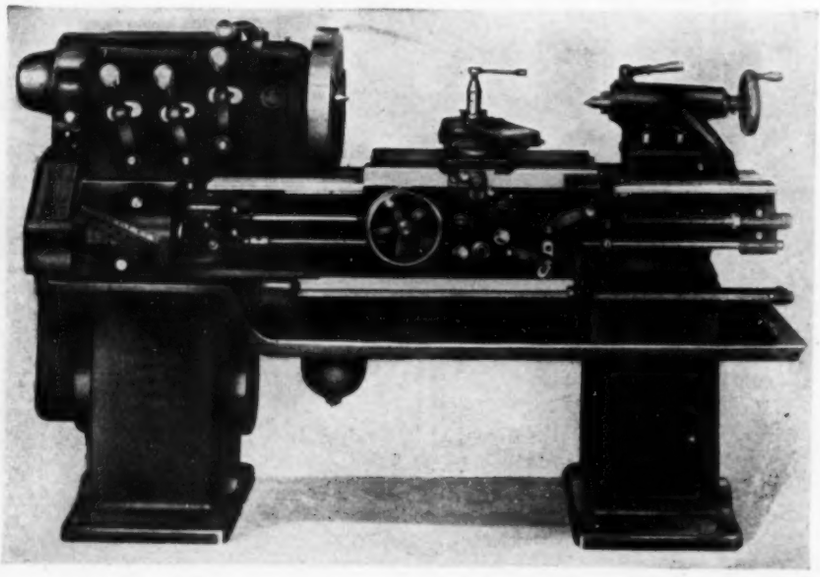
ford, Ill., and distributed by the American Safety Equipment Company, Detroit, Mich. Volatile and inflammable liquids generate static electricity when being transferred from one container to another, or when being run through a rubber hose. To eliminate this danger and make the pumping operation absolutely safe, the Trahern pump is made of materials which are non-ferrous, non-static and non-corrosive. The pump is equipped to be fitted on steel drums with 1½- or 2-in. bung screw openings, and an attachment adapts it for ¾-in. bung screw openings in the end of drums. The case is made of a special grade aluminum, while the running parts are of brass.

The principal parts are the collapsible suction pipe with packing gland on lower joint; bung screw independent of the pump, making it possible to turn the pump to any desired angle, and furnished in the sizes above noted; the pump itself; a discharge pipe equipped with a ball-check valve; anti-drip discharge nozzle to fit cans or containers from 1 to 5 gallons; a return-drip bowl to return excess liquid to the drum and to permit excess gases to escape from within the drum; a flame baffle; and a return-drip arm. For the filling of containers on the floor, a special hose attachment can be obtained. The return-drip bowl is arranged to hold the discharge end of the hose when it is not in use, and thereby avoid danger from fire.

Monarch High-Speed Lathe

TO MEET the demand for lathes that will operate smoothly and quietly at much higher than normal spindle speeds, the Monarch Machine Tool Company, Sidney, Ohio, has developed a line of high-speed lathes in sizes from 14 to 36 in. swing and providing maximum spindle speeds from 600 to 1,500 r.p.m. These machines are particularly designed to be used with the new tungsten-carbide cutting tools, such as Widia, Carboloy and various others now appearing on the market.

Helical gears and Timken bearings are standard on Monarch lathes so that only moderate further changes were necessary to qualify these machines for use with the tungsten-carbide cutting tools. According to the manufacturer, helical gears and Timken bearings used in the lathes enable them to operate with quietness, smoothness and precision, and the work shows no vibration nor gear-tooth marks even at the top speeds. With this high-speed lathe, it is possible to turn materials at production speeds never before attempted with the high-speed steel tools. Cast-iron is being turned at 500 to 700 surface ft. per min. and other materials at corresponding speeds. While designed particularly for high-speed work, these lathes may be used at the slower speeds, however, when cutting tools of high-speed steel are used. Tests show that at least twice the power is required for these high-speed lathes as for ordinary lathes operating at normal speeds, and the machines have been built to take care of this extra power. Naturally a far greater amount of metal is removed from the work in a given time with tungsten-carbide tools than with ordinary high-speed steel tools so that the greater expenditure of power is justified.



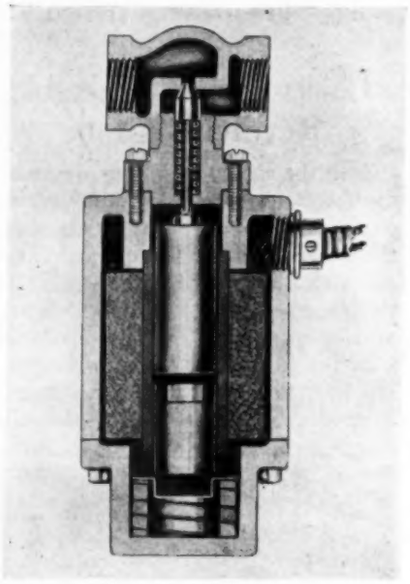
Monarch High-Speed Lathe especially developed for use with tungsten-carbide cutting tools

Electric Valve Manufacturing Company's Solenoid Valves

Automatic control of oil, water and air can be obtained by means of packless solenoid valves announced by the Electric Valve Manufacturing Company, 68 Murray St., New York, N. Y. These valves are governed by a thermostat, pressure regulator, or a float switch. As a special application, these valves can be supplied for pickling operations.

As shown in the illustration, the solenoid movement is constructed so that the rustproof steel plunger, which is directly connected to the stem of the valve, is allowed to slide in an airtight housing made of a special composition. This housing is sealed by means of a steel cap, which is forced down with great pressure by a high-tension spring. The oper-

ating parts of the solenoid are rustproof and the valve stem slides through a brass bushing The solenoid coil can be replaced without disturbing any other part of the movement, thus eliminating the necessity of any readjustment. The fluid to be controlled is allowed to flow into the plunger chamber without causing any injury to any part of the apparatus. To provide ample power to operate



Cross-section of an Electric Valve & Manufacturing Company's Solenoid Valve

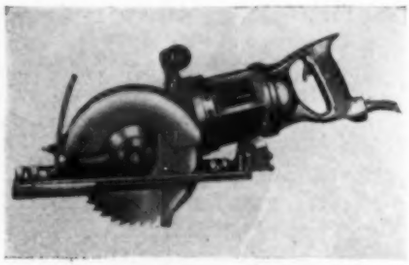
the valve under various conditions and ranges of pressure, several sizes of solenoid are used.

These solenoid valves can be operated direct from the lighting circuit. Three models are built, the first in sizes from ¼- to ½-in. pipe sizes for 90 lb. per sq.in.; the latter two from ¼- to 3-in. pipe sizes, mainly for low pressures, particularly as the size increases.

Black & Decker Electric Handsaws

Three electric handsaws, to carry 6-, 8-, and 10-in. saws respectively, have been placed on the market by the Black & Decker Manufacturing Company, Towson, Md. These portable tools will cross-cut and rip lumber up to 3½ in. thick, and in addition, can be used with a special metal-cutting saw. The saw blade is inclosed in a telescopic guard so that as the saw progresses in the work, the guard automatically telescopes. When the cut is finished it snaps back, entirely covering the saw blade. An adjustable shoe can be set to cut any depth up to the capacity of the saw when cutting rabbets. This shoe is also adjustable for cutting any angle up to 45 deg., for mitering or for the jointing of long edges. It maintains the angle throughout the entire length of the cut.

These units are provided with universal motors, and are shipped in a special carrying case. They are equipped with pistol grip and trigger switch for ease in handling and control. Ball bearings are used throughout and the gears and shafts are made of chrome-nickel steel. Gears run in grease in grease-tight compartments. The machines are air-cooled and will operate continuously without overheating. Standard equipment consists of one rip and one cross-cut saw, one adjustable saw fence, three-conductor cable with attachment plug, and a carrying case. Units can be furnished for 32-, 110-, 220-, or 250-volt circuits.



Black & Decker Electric Handsaw

Olsen-Lundgren Improved Centrifugal Dynamic Balancing Machine

IN ORDER to simplify the machine and reduce the time necessary to balance a shaft, several improvements have been made in the Olsen-Lundgren centrifugal dynamic balancing machine built by the Tinius Olsen Testing Machine Company, Philadelphia, Pa., and illustrated on page 906, Vol. 68, of the *American Machinist*. Although the general appearance of the machine remains the same there are important differences in design and construction, as can be seen in Fig. 1. Both ball and roller bearings have been abandoned as experience has shown that for this particular case, the plain bearing gives greater sensitivity, accuracy, and reliability. In a like manner the weights used in the former machine have been replaced by calibrated springs that are controlled by micrometer graduated barrels at each bearing of the shaft. In this way

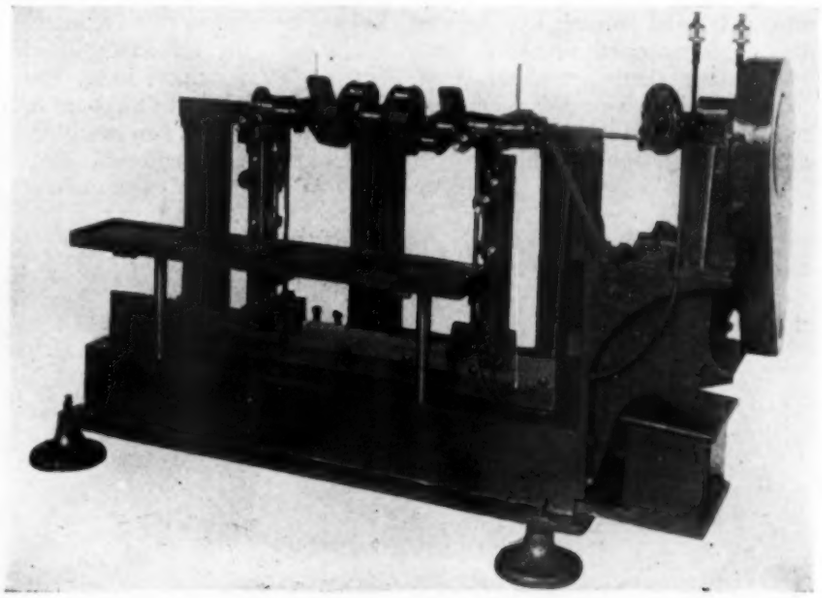


Fig. 1 — Front view of the Olsen-Lundgren Improved Centrifugal Dynamic Balancing Machine

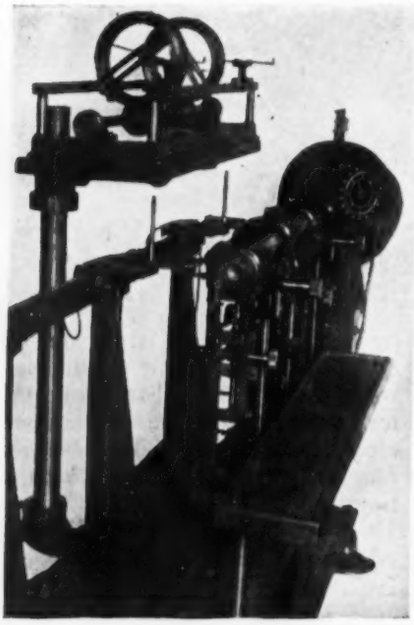


Fig. 2 — Left-end view showing the improved double-column support

the pressure due to unbalance is indicated directly in ounce-inches. The new design makes it easy to control the motion due to the centrifugal forces of the unbalanced weight whereby the average of the total unbalance is obtained as the support is free to oscillate in one direction only when the pressure readings are taken, but is free to operate in two opposite directions when the angle is taken. The support itself is also improved in design as shown in Fig. 2, where it will be seen, a substantial double-column type of support has replaced the single support formerly used. This change eliminates much of the disturbance and consequent error that had to be counteracted by further checking in the older machine.

When balancing crankshafts or any other revolving member, in large quantities, charts are prepared to show the operator all necessary information. These charts take the place of the transfer instrument that was illustrated in connection with the previous machine. The charts simplify the operation of testing large quantities of similar pieces and permit the operator to balance them in less time than before. The transfer instrument remains of great value however where a wide variety of work is to be handled on the same machine, and is supplied as before, whenever it is desired.

These balancing machines, besides being built for general work are also being supplied for special purposes, such as for small electric armatures weighing from 2 to 20 lb., while one of the latest machines has been developed for automobile propeller shafts as shown in Fig. 3. Owing to the presence of the universal joints at each end of these shafts the supports have free motion only in one direction. The same type of plain bearings are used and the calibrated spring with micrometer adjustment is also used in this machine. As with the machines previously described, this machine is completely wired so that it is only necessary to connect it with the electric power line.

The coupling, incorporating a ball-bearing universal joint that compensates for any ordinary misalignment between the spindle and the piece being tested is retained. The quick locking mechanism that facilitates the reading of the unbalance at either bearing, each support being entirely independent when readings are taken, is also found in the new machine.

It will be remembered that the method of indicating unbalance in these machines is by means of sparks that are made by a make-and-break contact when the piece being tested moves in its support. The position at which these sparks occur shows the angle of unbalance so that corrections can be easily made at the proper place. When the sparking ceases the amount of unbalance can be read directly from dials in ounce-inches and the amount of metal to be removed determined according to the reading at the phase of correction.

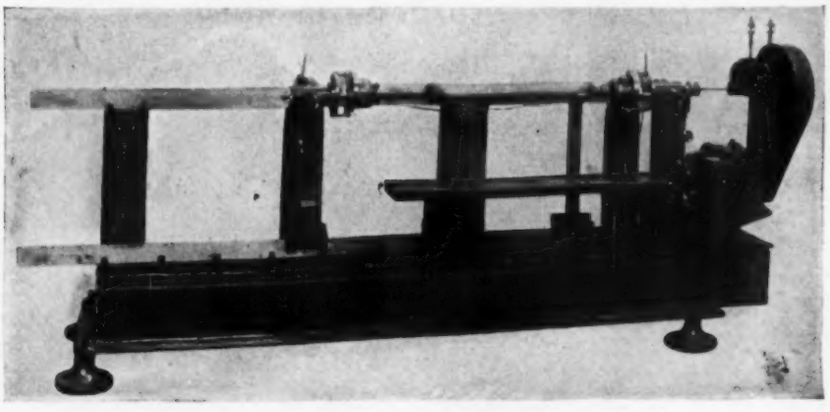
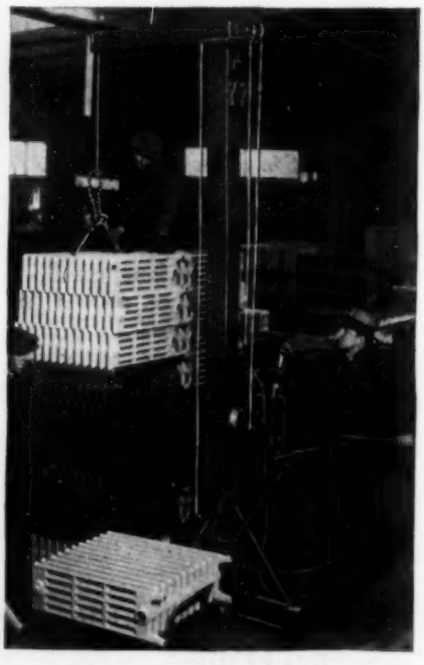


Fig. 3—Special machine for balancing automobile propeller shafts

Lewis-Shepard Portable Revolving Crane

For the ready handling of cases, crates, bales, castings, and similar items which it is desirable to stack, the Lewis-Shepard Company, Watertown Station, Boston, Mass., has developed a type of portable revolving crane. The crane hooks take the load directly from the hand truck or floor, elevates it and swings it around onto the top of the pile.



Lewis-Shepard Portable Revolving Crane

The machine can be revolved through a full 360 deg. travel and uses small aisle space. Where piling is done in dead-end aisles, loads can be picked up from the front of the machine and swung through a 180 deg. arc onto the pile. The machines are furnished for hand operation or with

motor drive for operation from a light or power circuit.

The machine pictured is equipped with a worm-gear-drive winch, and with reversing drum controllers, and the motor is protected with a thermal overload relay. Top and bottom limit stops control the crane travel, preventing possible injury to the machine through careless operation. A dead-man type of control automatically raises and control handle to its neutral position and applies the heavy-duty service brake.

Producto Two-Spindle Automatic Cam Miller

TWO different sized cams for radial aircraft engines can be milled simultaneously on the two-spindle automatic cam miller recently announced by the Producto Machine Company, Bridgeport, Conn. In the machine illustrated the cam being cut has eight lobes, four on each side, equally spaced and separated by a groove. The cams reach the machine roughly forged to shape and are finished at the rate of 5 to 6 pieces per hour.

In principle of construction the machine consists of a fixed work spindle carrying the cam, a fixed spindle carrying the two master cams of the same contour as desired on the work and driven at the same speed, and the two cutter heads sliding on dove-tailed ways. The movement of the cutter heads is controlled independently by follower rollers bearing against the master cams under spring pressure. These rollers are of the same diameter as the milling cutters so that the shape of the master cam is reproduced exactly on the work.

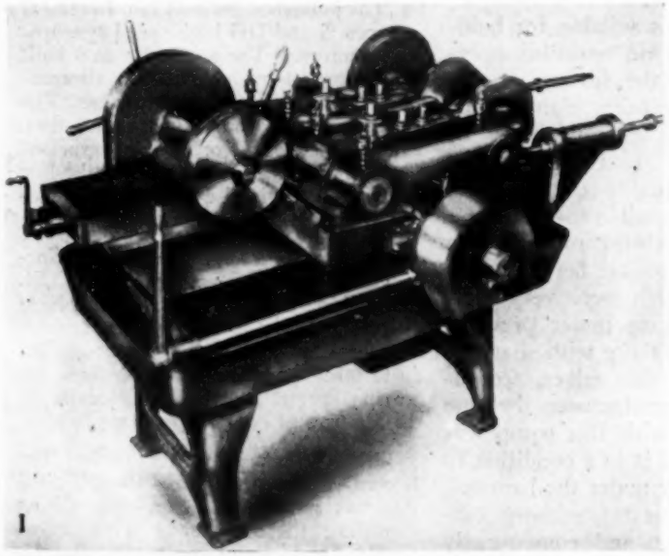
A feature of the machine is that either ball or roller bearings are used wherever feasible. In the machine illustrated taper bronze bearings with means for adjustment are used to carry the cutter spindles, but Timken tapered roller bearings are also available.

Drive of the machine is by a single pulley controlled through a Conway clutch by means of the lever shown in the foreground in Fig. 1, giving a front view of the machine. Hardened steel helical gears transmit the power from the main drive shaft to two fixed worm shafts which engage corresponding wormwheels on each cutter spindle. With this construction the cutter heads may be oscillated slowly on the bed, following the cam contour, without interruption of the drive. Necessarily the driving worms are made long so as to accommodate the wormwheels at the extreme positions. These worms are made of steel, hardened and ground, and are carried on radial ball and roller bearings with ball thrust bearings taking the thrust. The mating wormwheels are made of bronze and are held in place with nuts.

Each follower roller is carried on the end of an adjustable shoe so that the position of the respective cutter in relation to the work may be accurately set. A micrometer collar, shown on top of the cutter head, is used to make this adjustment using the usual crank handle Two locking bolts operating in a slot, shown just to the right of the micrometer collar in Fig. 1, are used to hold this shoe in place. Provision in the sliding head is made for shifting the cutter spindle to the opposite end so that it will cut a master cam. In this case a disk, of the same size as the cutter and carried on a similar spindle in the original position, follows a master workpiece carefully filed to shape.

In the same view may be seen the housing containing one of the helical springs used to hold one of the cutter heads against its master cam. It is possible to put this spring in either compression or tension as desired.

Both the work spindle and the master cam spindle are driven through duplicate sets of worms and wheels. Drive from the mainshaft is through change gears so that variations in the speed of both are possible. Because the work spindle makes only one revolution in ten minutes cast-iron bearings are used



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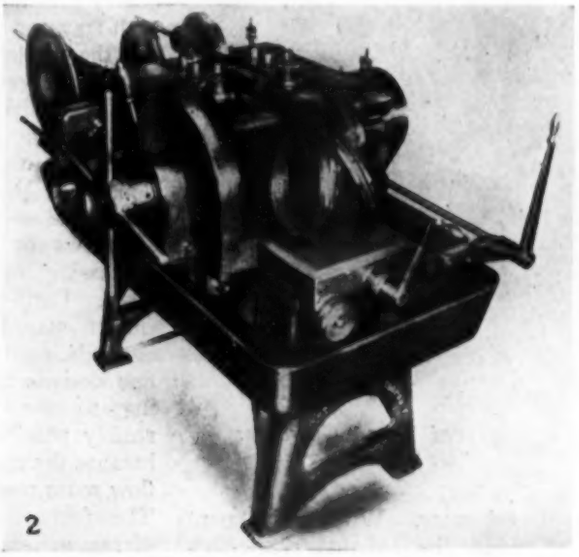

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Fig. 1.—Front view of the Producto Two-Spindle Automatic Cam Miller for radial aircraft engines. Fig. 2—Another view of the Producto cam miller showing the capstan wheel for clamping the work in place

with a hardened steel journal. To load the cam piece, it is mounted against a faceplate and held in place through a clamping plate and C-washer. The capstan wheel shown in Fig. 2 is used to clamp the work in place. A handcrank, shown in the foreground, is used to advance the work head toward the cutters and the micrometer stop at the immediate left of this handle controls the final position. Adjustable gibs prevent lifting of this work head under load.

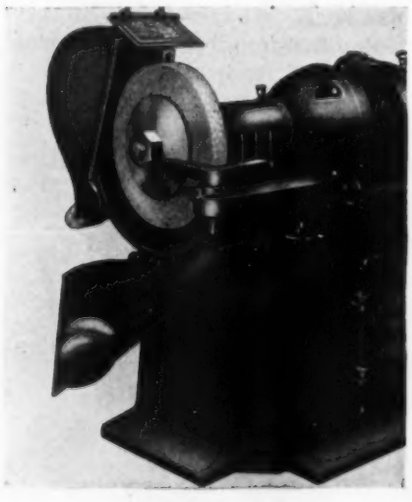
Cast integral with the base of the machine is an apron and coolant sump holding about 20 gal. A geared pump built into the machine and driven directly from the mainshaft provides ample circulation. Provision is also made for chip removal.

The worms and wheels operate in oil baths, which also lubricate the adjacent bearings, and in other locations sight oil feeders are used.

The machine occupies a floorspace of 45x70 in. and weighs 4,200 lb. net.

Improved Wheel Guard for "U. S." Grinders

An improvement on the line of heavy-duty grinders manufactured by the United States Electrical Tool Company, Cincinnati, Ohio, is the wheel guard illustrated. This guard is of the hinged-door type, adjustable



Improved Wheel Guard for "U. S." Grinders

o wheel wear. When adjustments are made, the exhaust connections remain stationary. It will be noted that the guards are made of heavy sheet steel and are readily opened up.

Brandt Non-Oxidizing Furnace

Annealing and soldering are facilitated by a furnace offered by the Brandt Engineering Corporation, Weisberg & Greenwald, Sales Agents, 71 West 45th St., New York City. In this furnace, production forms a continuous, straight-line operation. Trays of parts are put in at one end,

Brandt Non-Oxidizing Furnace

follow through in succession, and are unloaded at the other end. The furnace occupies a space 7 ft. long by 3 ft. wide. The only extra equipment necessary is an air line at ordinary pressure and a gas connection, with trays or pans suitable for holding the work. One unskilled operator can operate the furnace.

The special features claimed for this furnace are its uniformity of annealing under controlled conditions, and the quality of annealing which makes it possible to take deeper draws or perform more severe processing operations between anneals. Parts which were very difficult to manufacture under previous methods, such as those with sharp or fine designs and thin edges, according to the manufacturer become readily possible with this equipment because the metal is in a condition to flow more readily under the hammer. The furnace operates without oxidizing or scaling, and consequently eliminates bright-dipping. It is claimed that the furnaces will actually deoxidize metal that has been blackened by exposure to the flame of a blow torch.

In soldering operations, the parts are held together by appropriate means, the solder is placed in position, and trays full of work are put into the furnace, coming out finished at the discharge end. Since no oxidization occurs, the principal reason for using flux is gone. Hard solders are used instead of soft solders.

The furnace is suitable for annealing, soldering, and heat-treating not only steel, copper, bronze, and brass, but also rarer metals and alloys, such as nickel silver, gold, white gold, green gold, and other metals.

Trade Publications

CASTERS AND TRUCK WHEELS. Devine Bros. Co., Inc., Utica, N. Y., has published a catalog entitled "Devine Canvas Cushion Casters and Truck Wheels." know as Catalog No. 22. The details of construction, specifications, and available sizes of these casters and truck wheels are shown. All types are thoroughly illustrated. The catalog contains 29, 9x6-in. pages.

CHAIN. The American Chain Co., Inc., Bridgeport, Conn., has issued a folder entitled "Chain for Cranes, Dredges and Heavy-Duty Applications," which shows various sizes of chain and gives the weight per ft. together with the service-working load.

MOTORS. The Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has published bulletin No. L-1150-C on types G and HG high-speed synchronous motors. These motors are built to develop 60 hp. or more in all commercial voltages and frequencies. The leaflet contains four illustrated pages. Another leaflet, No. 20403 describes Class 1-210 reversing across-the-line starters for squirrel-cage induction motors.

MOTORS. The Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo., has published the third revision of Bulletin 151 on air-jacketed motors. It contains a discussion of dust, fume and moisture problems requiring special protection, and explains the features of construction employed.

THERMOMETERS, RECORDING. The Brown Instrument Co., Philadelphia, Pa., has published catalog No. 65 on recording thermometers. This shows standard and special apparatus. Specifications, and details of construction are given, together with photographs. The catalog contains 72, 11x8½-in. pages.

News of the Week

Machine Tool Builders Analyze Financial Statements

A COMPARISON of the financial statements of companies building machine tools with those of companies in 34 other industries was most enlightening to members of the National Machine Tool Builders' Association, if their comments on the comparison are any indication of their attitude. The figures were presented by Alexander Wall, secretary of the Morris Associates, a group of bank credit men, at the spring meeting of the Tool Builders at the Grove Park Inn, Asheville, N. C., on May 20 and 21.

The figures showed clearly how slowly the machine tool builder is able to turn his capital as compared with other manufacturers, and also what wide fluctuations in earnings occur from year to year. Mr. Wall pointed out that the experience of a whole industry in showing a net loss of over 5 per cent in 1921 was unprecedented. His figures for the machine tool industry could be taken only as indicative of conditions, he admitted, because they were obtained from but 15 or 20 per cent of the companies, and those probably the most efficient.

F. M. Feiker, managing director, Associated Business Papers, pointed out the importance of the part played by the business press in serving and educating modern industry. He was followed by W. H. Rastall, chief, Industrial Machinery Division, Department of Commerce, who commented on the expanding foreign trade in industrial machinery. His remarks are summarized on the next page in the Division's report.

All Available Exposition Space Taken

J. Wallace Carrel, Lodge & Shipley Machine Tool Co., and chairman of the exposition committee, reported that all available space for the exposition to be held in Cleveland, beginning Sept. 30, had been contracted for and that no cancellations had been received. Of the 242 exhibitors, 125 are members of the association, 35 are non-member machine tool builders, and the remaining 82 are accessory makers, dealers and business paper publishers.

A resolution was passed urging the exhibitors to reduce to the minimum the indiscriminate entertaining that was objected to by several important buyers who were present at the 1927 exposition.

President Henry Buker, in his address touched on the ever-present problems of the industry; trade-ins, free engineering service, adequate prices, standardization, cost of new designs, and cancellations. He complimented the dealers of the Chicago district on their success in solving the trade-in problem and expressed the hope that their plan would be adopted in other districts.

After commenting on the successful standardization that has been accomplished by the milling machine and grinding machine builders he said:

"Of course, there is a danger which should not be overlooked in any program of standardization of parts. Under no condition should we standardize parts to an extent that will hamper progress in design. Sometimes, to develop a machine to meet the user's requirements, the designer must ignore all established standards to make a machine which will produce the greatest amount of work possible in the easiest and most accurate way. The moment standardization interferes materially with progress, just so soon will standardization fail.

"We must keep this constantly in mind whenever we are discussing the standardization of parts. Standardize everything you possibly can that will make for economy and will not interfere with the efficiency of the machine. But do not forget that, after all, the customer is interested primarily in production and is not much concerned how that production is reached as long as it shows a lower cost per unit to him.

Restriction in Sizes

"Connected with standardization, although not quite identical with it, comes the question of restricting the number of sizes of machines that you wish to make of certain types. We all know that some sizes have a limited sale. They have been made to fill in the line, and in some cases, because competitors had similar machines which some one guessed it desirable to duplicate. With good methods of cost keeping, nearly all machine tool builders can know that some sizes they are making are unprofitable. Undoubtedly, most of them would be willing to cut out such lines if they felt sure that their competitors would do the same. Legal agreements can be made as to reduction in number of sizes and types of machines to eliminate much waste."

On the subject of the economics of new design Mr. Buker said: "It seems to me that the manager of a business must give the keenest attention to this subject of design, if he wishes to keep up with the times, and also has a reasonable desire to make money. Each manufacturer should face, clearly and definitely, just what it costs him to change to a new design, and should know beforehand, all that is involved. To do this, he must make a careful study of the market, and base his judgment as to the value of the design and the field it will occupy very largely on such a report plus his own experience with machines of a similar type.

"I would not for one moment suggest that machine tool builders stand still on the question of design. I only think that, with the present radical tendency, we must all guard against making changes unless we are convinced, looking ahead to the future, that they are desirable from a financial standpoint. Any design that has real merit and will produce work faster or more easily than the old designs should be developed—if the market is sufficiently large to reimburse the manufacturer. No matter how attractive a design is, and regardless of how much it may save in a limited way, unless it will make money for the stockholders of a business it ought not to be placed on the market. That is, unless you are prepared to charge the loss to cost of managerial policy and properly identify it in your report to your stockholders."

The Cancellation Problem

In concluding, the president had this to say of the cancellation problem:

"Many of us are now receiving more orders than we are able to fill promptly. Our deliveries are becoming more distant, and there may come a period where we shall be faced again with the cancellation problem. It may be a long time before we experience another depression, but if, in the meantime, you will see to it that your customers are duly impressed with their obligations, and if you gradually build up and strengthen in their minds a proper attitude on this whole question, they will be better prepared to make proper arrangements with you when the crisis does arrive.

"This whole question of cancellation, to my mind, is one of education. I believe that if, in times of prosperity, you use every effort to impress your customers that their orders are firm orders, and, in times of adversity, you have the courage to insist on an equitable adjustment in case of cancellation, our whole machine tool industry will be benefited and the grave danger of wholesale cancellations will become a thing of the past."

E. F. Du Brul, general manager of the association, reported that the membership had grown since the last convention to 138. He told of the success of the cost work of the association and urged the desirability of joint research in the field of the new cutting alloys to avoid the loss inseparable from individual efforts and duplication of effort. On the subject of standardization Mr. Du Brul said:

"It is quite evident that a very large proportion of the items standardized by a company into its own books of stand-

ards would be common to all machine shops. It seems to me from going over some of these books that perhaps 75 per cent of the standards they have established for their own use would be applicable in the whole industry. Is it not illogical and wasteful for each company undertaking this work to do over and over again what several other companies have already done? Why duplicate all that expense and in the end wind up with individual standards, very good though they may be, but not industry standards anyhow?

"I hope that our membership will soon realize that this is a wasteful procedure, and they will determine to employ an Association standards engineer to gather up all the available information; to work them over with the engineers of the members; then to develop Association standard sheets to be placed in the hands of the company engineers. Such a co-operative effort would save much expense which member companies will spend on wasteful duplication, unless the co-operative method is undertaken."

U. S. Exports of Metal-Working Machinery Show Large Increase in 1928

ACCORDING to a report issued by the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce, exports of metal-working machinery from the United States during 1928 totalled $34,125,000, exceeding those for 1927 by $8,746,000, or 34 per cent, breaking all records since the abnormal post-war year of 1920. This advance is the more significant when it is considered that the principal markets for this class of machinery are found in the more highly industralized nations which are themselves keen competitors of the United States, and indicates strikingly the progress which the latter is making in these highly competitive markets—a marked tribute to American machinery of this type.

Repeating the experience of last year, the outstanding development in the foreign metal-working machinery trade during 1928 has been the sharp gain in exports to Europe which rose by 41 per cent over those in 1927. Moreover, in 1928, Europe absorbed over 60 per cent of the total as compared with 57.5 per cent in 1927 and 51.4 in 1926. This proportion, however, was less than in 1925, when exports of metal working machinery to Europe represented 63.4 per cent of the total. Sales to Canada and Newfoundland showed a gain of 49 per cent over 1927 and these countries increased their participation in the total from 18.4 per cent in 1927 to 20.4 in 1928. Shipments to Latin America and Asia also rose substantially, but the proportion of the total absorbed by both of these areas fell slightly under 1927 figures.

With the single exception of the year 1926, Europe's proportionate consumption of American metal-working machinery has shown an upward tendency since the end of the slump in 1922. Proportionate sales to Canada and Newfoundland have also shown an increasing tendency since 1925, but although the relative standing of Latin America as an outlet for American metal-working machinery has declined in the last two years and that of Asia generally since 1922, the value of equipment sent these two regions is expanding significantly.

The accompanying bar chart, Fig. 1, affords a basis for comparing metal-working machinery exports over a period of years. The consistent increase for nearly all areas in the value of foreign shipments during the last five years is notable, as is the striking contrast with pre-war experience. Fig. 2 shows the history of the exports of metal-working machinery, not only from the United States but from Great Britain and Germany. The predominance of the American position is quite strikingly illustrated and the favorable trend of recent years not only is significant of the substantial character of this trade, but should be very gratifying to all American interests. During the last few years, however, the volume of exports of German metal-working machinery has exceeded that from this country.

In considering this point, however, it should be remembered that German shipments include reparations in kind, which account for a very substantial proportion and are a peculiarly difficult form of competition. This is illustrated, for ex-

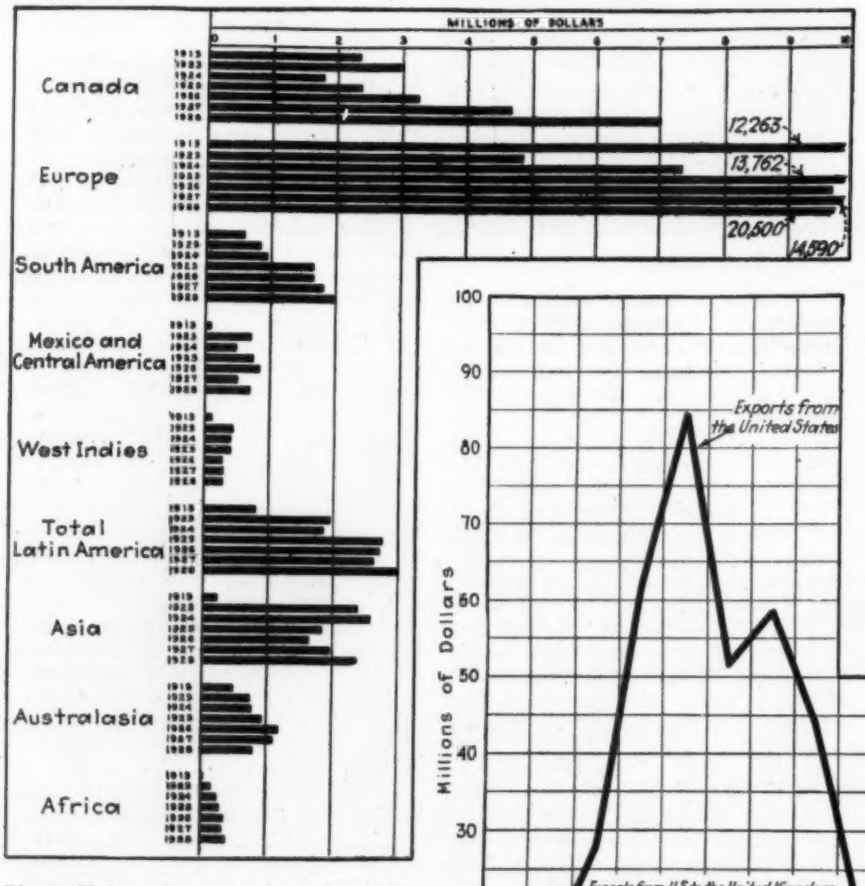


Fig. 1—Values of exports of metal-working machinery from the United States by continental groups

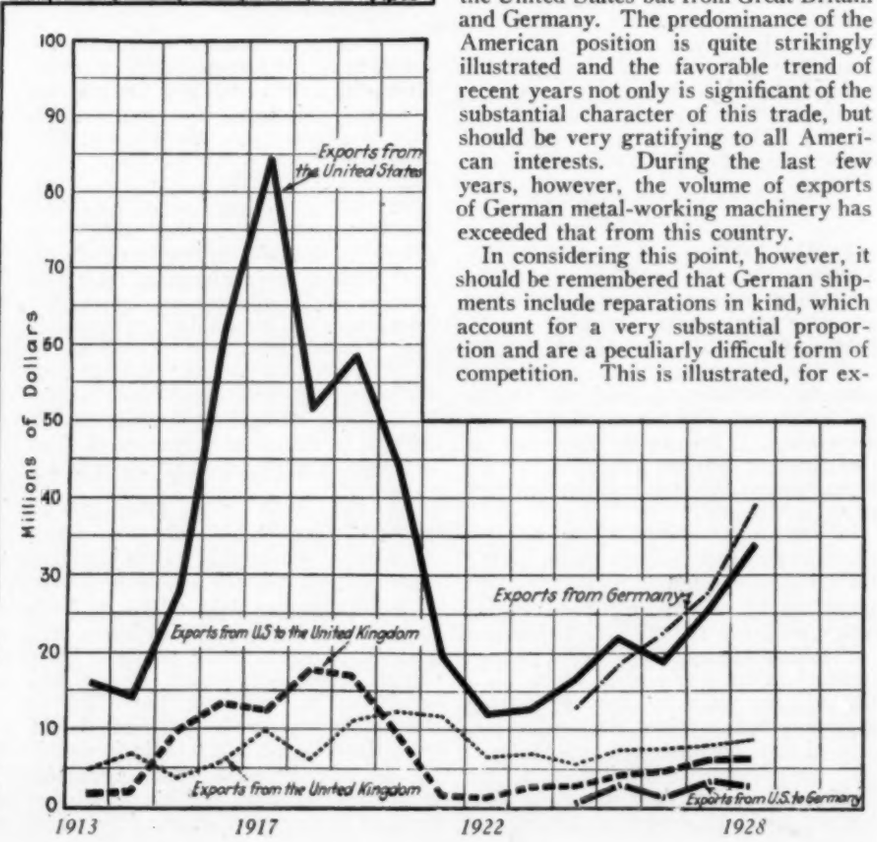


Fig. 2—Comparison of the trend in value of exports of metal-working machinery from the United States, the United Kingdom and Germany

ample, in France, where the French Government passes this machinery on to French industries at a price substantially lower than that which is allowed to the German manufacturer and credited to reparations.

In studying the accompanying charts and statistics, it should also be remembered that, generally speaking, American machinery is relatively high in quality and commands corresponding prices. For example, on the British market, it is not uncommon for American metal-working machinery to command double the price per pound that is secured for German equipment in the same market. Consequently these charts and figures represent quality competition in the face of machinery made to a price ideal.

Among the various individual countries, Canada, whose consumption of American metal-working machinery during 1928 increased by 50 per cent over 1927, replaced the United Kingdom as the leading market for American machinery of this type, although the latter increased its purchases by 11 per cent over 1927 and ranks next in importance. France, whose purchases were double those of the previous year, took Germany's place as the market third in importance. However, while exports to the latter fell by 21 per cent under 1927, Germany nevertheless stands fourth, followed by Japan, which increased its consumption of American metal-working machinery by 15 per cent over 1927.

The upward trend in exports to Russia (in Europe) has continued, shipments totaling approximately $1,193,000 in 1928 as against $1,046,000 in 1927, $538,000 in 1926 and only $930 in 1922. In spite of this showing it should be remembered that the Russian market has its own peculiar character and limitations and deserves especial study and careful treatment, as the whole situation there might be called abnormal. Another important customer in 1928 was the Irish Free State whose purchases approximated $1,160,000 although in previous years the amount absorbed by this country has been unimportant.

Among the lesser markets, exports to Belgium, Italy, Czechoslovakia, Brazil, Sweden, Panama, Poland, Bolivia, Austria, Finland, British Malaya and Uruguay, all showed sharp increases over 1927 figures. On the other hand, there was a drop in sales to Australia, British India, Spain, Chile, Venezuela, Colombia, Switzerland, Cuba, Peru, New Zealand and Greece.

Westinghouse Joins with French Concern

The Westinghouse Electric International Co., a foreign subsidiary of the Westinghouse Electric & Manufacturing Co., has concluded negotiations to form a joint electrical manufacturing company in France with Schneider et Cie, a leading French industrial organization. The new company will be capitalized at about $4,000,000. The present head of the Schneider family, Eugene Schneider, will be chairman of the new company, and L. A. Osborne, president of Westinghouse International, will be vice-chairman.

The present electrical plant of the Schneider organization, consisting principally of the Champagne Works, will be operated by the new company. The Schneider - Westinghouse organization will concentrate on the building of all types of heavy machinery for railroads, steamships and power plants. It is expected that the formation of the new manufacturing company will stimulate rather than cut down American exports of electrical machinery.

Another example of an American company buying into a foreign concern, also in the electrical field, is the entry of the International Standard Electric Corporation, a subsidiary of the International Telephone and Telegraph Co., into the manufacture of electrical communication apparatus in Germany by acquiring a substantial interest in the Ferdinand Schuchardt Berlin Telephone and Telegraph Works. The Schuchardt Works, which now employ about 1,500, will be expanded immediately.

Automotive Production High in April

According to the Department of Commerce, April production (factory sales) of motor vehicles in the United States as reported to the Department was 620,656, of which 537,225 were passenger cars, 81,977 trucks and 1,454 taxicabs; as compared with 584,907 passenger cars, trucks and taxicabs in March and 410,104 in April, 1928. Canada's total production declined in April to 41,901 from the March figure of 49,621. Total production was 24,211 in April a year ago.

Foremen to Meet in Indianapolis, June 7-8

The sixth annual convention of the National Association of Foremen is to be held in Indianapolis at the Claypool Hotel on Friday afternoon, June 7, and all day Saturday, June 8. At the Saturday morning session Hon. James J. Davis, Secretary of Labor will speak on "Opportunities in Industry," and in the afternoon Alfred Kauffmann, president of the Link-Belt Co., Chicago, will talk on "Some Trends in Industry." Dr. Harry Myers of the Frigidaire Corporation of Dayton, Ohio, will discuss "Two Basic Principles of Good Work," on the morning program, followed by four separate foremen's conferences held at the same time.

H. H. Flagg of the General Motors Corporation, will address one group on the subject "Wage and Production Incentives." A second conference group will hear Dr. Myers speak on "How Can We Interest Our Men in Order and Care of Property?" "Elimination of Waste in Industry," will be the subject on an address by G. E. Tibbits, of S. F. Bowser Co., and the last group will have as its subject "Developing Our Personality," with Harry N. Clarke of The Business Clinic at Cleveland, leading the discussion.

There will be four additional conferences in the afternoon with the following speakers and subjects: G. F. Buxton, Purdue University, "How to Keep Men Interested in Their Work"; William Baum, Real Silk Hosiery Mills, "Budgetary Control for Foremen;" John Doran, G. A. Gray Co., Cincinnati, "How to Plan Your Work;" Carl L. Storck, General Motors Corporation, "Advantages to Be Obtained From a Shop Foremen's Club."

On Friday afternoon delegates in attendance will be taken on a tour of plant visitations to several large manufacturing plants, including E. C. Atkins & Co., J. D. Adams & Co., Diamond Chain & Manufacturing Co., Fairbanks-Morse & Co., Indianapolis Glove Co., Marmon Motor Car Co., Real Silk Hosiery Mills, Rockwood Mfg. Co., Stutz Motor Car Co., and the U. S. Rubber Company.

McGraw Gives $50,000 to Engineering Library

At the tri-annual meeting of the Engineering Foundation, held in New York, May 23, an announcement was made by H. W. Craver, director of the Engineering Societies Library, of a gift of $50,000 to the library endowment fund by James H. McGraw, chairman of the board of the McGraw-Hill Publishing Co. The guest of honor at the meeting was Dr. Harvey N. Davis, president of Stevens Institute of Technology, who spoke on recent research in the properties of steam. H. Hobart Porter, recently elected chairman of the Foundation, was inducted into office by Lewis B. Stilwell, retiring chairman.

Announcement was made also of three offers of co-operation in research, one by the Society of Naval Architects and Marine Engineers, another by the Battelle Memorial Institute, and the third by the Bureau of Standards. The Society of Naval Architects proposed to combine its funds annually available for research with those of the Engineering Foundation in the interest of more effective use. A resolution was adopted accepting the offer, which would become effective in 1930.

The Battelle Memorial Institute offered $50,000 for the Alloys of Iron Research ($10,000 a year for 5 years) on conditions that were accepted by the Engineering Foundation. The Institute further offered its co-operation by placing its laboratory facilities at the disposal of the Foundation. The Bureau of Standards expressed its interest in the Alloys of Iron Research and offered the services of its staff to the amount of $1,000 a year for five years with the courtesies of its library and laboratories.

BUSINESS BAROMETER . . . . *Business is not as active as it was, but stocks are not excessive, and there is no enforced liquidation anywhere*

By THEODORE H. PRICE
Editor, Commerce and Finance, New York

From this page the reader will get a quick picture of current business and industry. The boxed material below is a summary of the letters from regional correspondents of the American Machinist, published in full on the opposite page.

THE economic history of last week includes a number of developments that attracted wide attention. It is hard to say which of them was the most important as their relativity depends upon the point of view.

In Wall Street the decision of the Supreme Court in the case of the St. Louis and O'Fallon Railway is regarded as an epoch-making pronouncement. It is generally construed as establishing the present cost of reproduction as a basis for the valuation to be put upon the railroads of the United States by the Interstate Commerce Commission, thereby adding about 11 billions of dollars to the sum upon which the railroads are entitled to earn 6 per cent before the recapture clause of the Transportation Act becomes operative.

Upon this theory the railroad stocks had a sharp advance. Part of the gains were lost when it was realized that much additional litigation and time would be required to determine the final valuation, and that it was doubtful whether the roads would be permitted to raise their rates to a point that would yield the additional income to which the increased valuation would seem to entitle them under the "fair return" provision of the Act. President Hoover promptly grasped this rate bull by the horns, expressing the opinion that the decision would result in no advance.

But outside of Wall Street the development that probably attracted most attention was the continued decline in wheat, which is now down nearly to $1 a bushel, as compared with a high of $1.33 a bushel for the calendar year. The decline represents a depreciation of nearly $56,000,000 in the value of the surplus supply that will have to be carried over, and a much greater decrease in the sum that the American farmers will receive for the yield of 1929, unless a substantial advance in the value of the growing crop is established before it is marketed. It is too early for prophecy, but the possibility that the income of the farmers from their wheat, cotton and other cash crops this year will be less than last is disturbing to those who look ahead to the autumn.

Then there is the money question which constantly raises its head and will continue to do so until what the Reserve authorities consider a "satisfactory" reduction of brokers' loans has been accomplished. The latest development is the action of the advisory committee of the Federal Reserve System in recommending that the Banks shall be allowed to raise their rediscount rate to 6 per cent. As the expected advance was not made last week the policy evidently is to hold it as a threat over the bull speculators, and the result has been a decline in stock prices which has carried even some of the so-called "investment issues" 25 points or more off from the season's high.

In the circumstances it is not very important that call money has been easier and that the Reserve Banks' statement last week revealed the strongest position this year with a reserve ratio above 75 per cent. For what the authorities are concerned about is not the state of the central reserves but simply that so many undistributed securities are being carried upon borrowed money.

On or before July 1 the stockholders in many important corporations will be entitled to exercise rights involving the payment of nearly a billion dollars for new stock offered them at prices which seem presently attractive. The amount of money involved is so large that tact will be required in providing it, and in redistributing the securities for which it will pay.

A fourth development of importance is the continued difficulty in reaching a settlement of the reparations question that is reported from Paris. Nevertheless many concesstions have already been made on each side and if a solution is finally arrived at it will be all the more stimulating for the discouragement that now prevails.

Then there is the situation in Washington. Considerable delay in passing a farm relief bill that will be satisfactory to President Hoover seems inevitable, and the same statement is true of tariff revision, which seems doomed to hearings and debate in the Senate for most of the summer.

Viewing the outlook in its entirety, it cannot be said that it encourages a revival of the boom in the stock market.

But little recession is yet apparent in the trade through which essential staples and necessary luxuries are distributed. Business is not as active as it was, but stocks are not excessive, and there is no enforced liquidation anywhere.

Cotton goods are quiet and more talk is heard of impending curtailment. A slight improvement in the market for woolen fabrics is to be noted, and rubber has been quite active with wide fluctuations. Copper is well maintained at 18c. a pound, and there is no doubt that the producing interests are so well organized that they can maintain that price if they care to do so.

In the industries a few signs of seasonal curtailment have appeared. The automobile manufacturers undoubtedly have passed their peak, but iron and steel are not yet affected. A prominent government official is quoted as saying that the United States is enjoying a period of "prosperous tranquility," and his statement would seem to be a fairly accurate description of the present situation. If it can be maintained, all will be well, but abnormally low prices for grain and cotton might disturb the tranquility alluded to.

EARLY in the month there seemed to be a slight but noticeable let-up in the sales of machine tools in various sections of the country, attributed in a large measure to the extended deliveries quoted. Now, if anything, there has been a slight increase in business as the month closes. New England reports sales for the month slightly below those of April, with the dealers and manufacturers welcoming the slight relief that is giving them time to catch up on the rush of orders received during the early months of the year. In Indianapolis also, the spring rush is over but a steady volume of orders continues to flow in. In Detroit, May business was also slightly below April but in the past week an increase in sales was noted.

IN NEW YORK, on the other hand, renewed activity was noticeable in May, after a slight let-up in April. There, with an increase in both orders and inquiries during the past few weeks, machine deliveries are steadily falling behind. All kinds of industrial plants are represented in the buying, and only the railroads seem to be inactive. Conditions in the South have been steadily improving since the first of the year. Sales of textile machinery are the highest in the history of that section. The railroads are also active buyers of equipment, and in Chicago the railroads are gradually reducing their outstanding lists.

AUTOMOTIVE buying leads in the Indianapolis territory and has been a contributing factor, of course, in the Detroit area. Changes in the motor plants are anticipating further machinery purchases, but one of the chief sources of machine tool orders has been the small tool shops springing up in that section to serve the automotive trade.

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The Industrial Review

Weekly progress of the machinery and machine tool business

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

DETROIT

The total volume of sales during the month of May as reported by machinery and machine tool dealers in the Detroit district shows a slight dropping off as compared to the totals for April. In spite of this situation there is a definite note of optimism throughout the trade and most dealers and industrial observers believe that the remaining months of 1929 will compare fairly well with the first five months. This does not mean that sales will be as high as during the extremely profitable period at the first of the year, but it does mean that no sudden depression is expected.

The fact that sales are keeping up as well as they are is particularly interesting in view of the long and unusual period of prosperity that has been experienced. Last year was by far the most profitable one in the history of the machinery and machine tool trade here, and the early months of 1929 were even better. About six weeks ago a gradual tapering off began and many dealers and manufacturers expressed the belief that this was the beginning of a slump. Since that time sales have picked up a little and are now maintaining a fairly steady pace.

The biggest demand is for tool and die room equipment. A great many orders are being placed by the small tool shops doing work on contract for automobile and accessory manufacturers. An unusual increase in the number of these shops has been noted over a long period of time and this tendency still persists. Many of the leading companies are planning large extensions, either building new plants or adding to present buildings. Much of this type of business comes from the automobile manufacturers who are planning changes and new models.

Because of the unprecedented volume of production in the automotive industry a large amount of replacement machinery has been bought. There are also many interesting developments in prospect in the motor industry. A great many radical changes are being planned, and it is likely that they will involve the purchase of enough new machinery to keep the trade fairly busy.

Other industries have supplied a fairly reliable market during the past few months. Paper and furniture manufacturers have done considerable buying and recently the steel industry has come to occupy a position of importance as far as the machinery trade is concerned. Airplane construction is coming to mean some new business and the growing importance of motor boat manufacture offers another outlet for equipment.

CINCINNATI

Machine tool manufacturers in the Cincinnati district report that in the past week the demand continued at a good level. In some cases the sales were slightly larger than in the previous week and in some cases there was a slight loss, but taking the trade as a whole there was very little change found in market conditions.

Selling agents report that the market in local and adjacent territory remained quite active, the demand being largely confined to single tools and replacements. The feeling expressed in this branch of the trade is that sales will remain at a good level until vacation-time brings about a seasonal lull.

With the manufacturers the sustaining feature of the week's market was the sale of single tools to miscellaneous users. Orders booked came from all sections of the country and were well diversified. The purchases of railroads and concerns in the automotive industry also were largely confined to single tools.

Manufacturers report the week's inquiries as being satisfactory both as to volume and nature. Here and there the requirements were two or three tools, but inquiries for single tools predominated. Prospects developed were well diversified as to sizes and types of tools and they were well scattered over the country.

CHICAGO

An even level may be said to characterize the condition of the machine tool market at this writing. Business in all lines is being well maintained, new orders being reported from various sources. Most tool manufacturers representatives and distributors state that the average of May sales will equal that of April; some note slight recession from April's volume, while others again report a perceptible advance over last month. No let-up of importance is looked for within the next few weeks.

Railroads are gradually reducing the number of items still outstanding on their lists, but evince no haste in so doing. They test the market carefully before closing. The Santa Fe, Northwestern, Burlington, Rock Island, St. Paul and Union Pacific are the roads chiefly interested. Thus far, the Illinois Central has limited its buying to actual necessities, and it is not expected to become a factor this year.

The looked for issuance of lists by farm implement and tractor builders has not yet been reported, but the belief prevails that it will not long be deferred. Used tools continue active, but most of the desirable stock in the hands of dealers has been contracted for. Deliveries still are slow, with no prospect held out for early improvement.

NEW ENGLAND

Early indications regarding May sales of machine tools in New England, point to a total volume below the month of April, but representative of good business. It is apparent, however, that the difference in totals will be comparatively slight. A market lull has resulted from the constantly extended deliveries on machine tools experienced over a period of several months.

Buyers are in more or less of a quandary. Builders are not in a position to give positive guarantees that machines will go forward, even as promised. Consequently lists are being placed only after deep consideration. Under such conditions the present steady subsiding in the rush of orders should prove more beneficial to the industry than harmful, and manufacturers will be afforded the opportunity to make definite headway on unfilled orders.

The week was quiet, although inquiries would indicate unabated activity, which, however, was not substantiated by actual orders placed. These were again confined to single tools spread over a favorable number of industries. Jig borers, a shaper, presses, drills, lathes and grinding units were illustrative of the demand. New aircraft manufactories are indicated for Bethany and New Haven, Conn. The used tool field was stimulated by auction sales of plant equipment, disclosing a good supply of readily salable units.

SOUTHERN DISTRICT

Improvement in machinery and machine tool business was reported by distributors in the southern district the last two weeks, the total volume of business being now fully as large as it was at this time last year, with inquiries in sufficient volume to indicate that sales will continue fairly active during the next several weeks. As a whole, however, conditions appear to be somewhat spotty, for while there are some industries that are placing very few orders, there are other that are buying on an unusually good basis, particularly the textile industry. It is doubtful if there has ever been a period when sales to textile mills were as heavy as they are at this time in the Southeast, and as the industry is investing several million dollars in new mill construction it seems certain that this business will continue to hold up on an active basis through the summer months.

Railroads operating in the Southeast are also more active in the machine tool market than they have been, and are placing some excellent orders for heavier equipment to be used in new shop construction projects now under way, and for replacement of some equipment in other shops. Inquiry is also good from this class of buyer.

Road-building machinery is reported active all over the Southeast, and there has been a steady improvement in demand from contractors for building machinery of late because of the more favorable weather prevailing which has resulted in a marked increase in building activity. Woodworking machinery sales, however, continue rather slow, and few sales are also reported to smaller machine shops and garages for other than used or rebuilt equipment.

CANADA

Of outstanding interest to the metalworking industry generally in Canada is the announcement that the Canadian National Railways have drawn up an expansion program which will involve an estimated expenditure of approximately $35,000,000 for general improvements to the transport systems, including rails, freight and passenger facilities, new bridges and new ships for the Pacific Coastal service. New equipment payments are estimated at $6,313,400.

The Toronto Transportation Commission has just sent out specifications and asked for prices on 110 new street cars. The Abitibi Power and Paper Co. will carry out a program of expansion at the Sault Ste. Marie mill this summer which may exceed $1,000,000. A permit for the construction of an $80,000 building adjacent to the Riverside Iron Works in Calgary, Alberta, has been taken out by officials of the Dominion Bridge Co. Further expenditures for machinery will swell the total to $250,000.

Bridge firms continue to benefit from the many new projects being undertaken in various parts of the county, and it is understood that there are several substantial contracts to be let during the course of the year. The Canadian Car and Foundry Co. is reported to have over $35,000,000 of business on its books and expects to reach the $40,000,000 mark before the end of the year. Operations at the James Smart plant at Brockville of the Canada Foundries and Forgings Co. are being carried on at capacity. The volume of business has grown to such an extent that the management is considering plans for the extension of plant operations.

Advices from Canada's trade commissioner in France, who has just completed

an extended tour through Morocco, Algeria and Tunisia, are to the effect that a splendid market is opening up for Canadian machinery in that part of the Continent. The Dominion is already selling to Morocco approximately 2,000,000 francs worth of machinery and spare parts annually.

INDIANAPOLIS

With the first spring rush of business over, the machinery and machine tool trade appears to have settled down to a steady business that, while not phenomenal, is encouraging because of its steadiness. Perhaps the most active purchaser of machine tools now is the automobile industry. Schedules are not being increased at the factories to any marked degree now, but most of them are working nearly to capacity and the prospects for continued business during the summer are good.

Much the same situation is true in the body manufacturing industry and the accessory field. The body manufacturers are rather steady buyers of special machinery, much of it woodworking machinery, stamping machines and other similar equipment.

Some slump has been seen in demand from the farm implement factories and the coal industry. This is to be expected this time of the year and is nothing unusual. On the whole the demand from these two industries during the past season has been better than for the last year or two.

A good demand now is seen for equipment for small tool and die shops and machine shops. Business with these industries seems to be very good and some of them are behind with their orders.

The contractors of the state, both building and road contractors, are buying their immediate needs. Weather conditions have held back this trade somewhat, but a couple of weeks of dry weather will do much to stimulate it for there is a vast volume of work in prospect.

Demand for airplane hangar equipment continues unabated as also does the demand from the radio trade, each industry being actively in the market for its special requiremnts.

Second-hand equipment dealers report a fair demand and a large volume of inquiries.

NEW YORK

After a slight let-down during April, which has become evident as data from various sources has been collected and compiled, the month of May shows a renewed activity in machine tool buying. Practically all lines represented in the Metropolitan area report not only a greater number of inquiries but also appreciably increased sales. The intensified activity is probably most marked in medium-size and large-size equipment, but small machines also are moving at a faster rate. The export trade moving out of New York to countries where American-operated plants are in production, also is markedly greater. Business has developed faster as the close of the month approaches.

Prices are holding or stiffening, with the general prospect of rising gradually during the coming months. One grinder firm has sent out notices of a contemplated increase to take effect June 1st.

Deliveries are not catching up. In some cases they are falling further behind, and some orders are not being filled until a month after the promised date. The usual lines of smaller machines, such as drill-presses and lathes, are quoted with deliveries at five to six weeks. Larger sizes run between two and four months, standard production tools with special fixtures cannot be furnished in less than three months, milling machines require twelve to fourteen weeks, boring mills five to six months, and in some cases both milling machines and boring mills are scheduled for delivery in January or February.

May business seems to be mostly expansion. Orders, as usual, cover a wide spread of industries and are for one or two machines in most cases. Railroad shops seem to be the only machine tool users not doing much buying. The Delaware, Lackawanna & Western orders, on which quotations were filed about May 1st, are still unplaced.

One dealer reports several orders, running up to five figures each, about to be closed. Airplane, airplane engine, electrical, radio, motor car, auto accessory, elevator, paper mill and shipbuilding industries are all in the market and buying. Trade schools in New York and vicinity are asking for quotations. Sheet-metal products firms are making especially large purchases. The Western Electric Co. is still ordering equipment for Kearny and Baltimore, the Sigoursky Airplane Co. is adding many new machines, and the Intertype Co. continues to place orders for equipment for its new plant.

Triplex Machine Tool Co. sales last week included: one Swiss jig boring machine; one Hydraulic arbor press; one Ames bench lathe; two Excel filing machines; and one floor grinder.

Business Items

The Warner & Swasey Co., of Cleveland, Ohio, has formed a Pacific Coast branch known as the Warner & Swasey Co. of California, with office and warehouse at 1118 Santa Fe Ave., Los Angeles. L. R. Hawkins is district manager and vice-president of the new company. For the past eight years he was resident manager for the Pacific Coast. B. W. Dimend will assist Mr. Hawkins in handling sales in the Southern California district and J. A. Craig will act as service engineer.

The Century Electric Co., St. Louis, Mo., has purchased Roth Brothers & Co., Chicago, manufacturers of motors and generators, and will operate the plant as a division of the Century company. The Roth line will supplement the Century line of polyphase induction motors and single-phase motors with d.c. motors and generators and a.c. generators, together with motor-generator sets.

The Groetchen Tool & Manufacturing Co., manufacturer of "Copper Head Laps," whose entire factory was destroyed by fire on February 1, announces that it has taken over the plant of the Edwin E. McMorran Co., located at 126 North Union St., Chicago. The plant has been greatly enlarged so that the Groetchen company is now able to make prompt deliveries of its product.

The National Twist Drill & Tool Co., of Detroit, has acquired a substantial interest in the Winter Bros. Co., Wrentham, Mass., manufacturer of taps and dies. The present management and officer of the Winters company will remain intact, and Messrs. John, Murray and Charles Winter will continue in their same positions of executive management as heretofore.

The Chicago Steel & Wire Co. and its associate, the Fusion Welding Corporation, both at 103rd St. and Torrence Ave., Chicago, announce plans for the construction of a new general office, adding over 8,000 sq.ft. to the space they now occupy. Growth of the business has made necessary this additional space.

General Motors Corporation has acquired the Allison Engineering Co., of Indianapolis, Ind., which has recently been devoting considerable attention to the development of aviation engines, including those of the Diesel type. According to Alfred P. Sloane, Jr., president of General Motors, the purpose of the acquisition will be to expand the Allison company's activity along these lines.

The Gisholt Machine Co., which recently purchased the plant and patents of the Comet airplane concern at Oakland, Calif., is planning to manufacture the planes at the old Northern Electric plant at Madison, Wis., now owned by Gisholt. The Comet is a 7-cylinder, 150-hp. radial type engine approved by the Department of Commerce.

The Brown Instrument Co., of Philadelphia, has moved its Boston office from 161 Devonshire St., to 1107 Public Service Bldg., at 89 Broad St., in the same city. The change has been made to provide larger quarters due to the growth of the company's business in the New England territory.

The Merrill Machinery & Supply Co., Merrill, Wis., has changed its name to the Merrill Manufacturing Co., and has increased its capitalization to $100,000. The company will continue to do machine repair work and make special machinery.

The Wilson Manufacturing Co., 707 N. Scott Ave., Wichita Falls, Texas, manufacturers of oil well machinery and supplies, will start this month an enlargement program in which an addition to the machine shops is planned.

The Viking Seaboat Corporation, New Haven, Conn., recently organized, has taken lease of 20,000 sq.ft. of floor space in the plant of the Winchester Repeating Arms Co. for the manufacture of amphibian planes. R. D. Thomas is an official.

The Dunn Manufacturing Co., Oxnard, Calif., has been merged with the Byron Jackson Co. with headquarters in Los Angeles. The Oxnard plant will be closed and the Dunn Manufacturing Co. dissolved.

The Chase Companies, Inc., Waterbury, Conn., brass and copper producers, have consolidated with the Kennecott Corporation, one of the largest copper mining companies in the world.

Personals

LOUIS RUTHENBERG, has been selected president and general manager of Copeland Products, Inc., Detroit, manufacturers of refrigeration machines. For the past two years, Mr. Ruthenberg has been president and assistant general manager of the Yellow Truck and Coach Manufacturing Co., and its subsidiaries, with headquarters at Pontiac, where he supervised the planning and construction of that company's new plant. For many years he has been associated with enterprises now a part of General Motors. He became assistant chief engineer for Dayton Engineer-

ing Laboratories Co. in 1912, was made general superintendent in 1916, and in 1922 assumed the additional duties of manager of the manufacturing division of General Motors Research Laboratories. In 1923 he became general manager of the Yellow Sleeve Valve Works, Inc., of Moline, Ill., a subsidiary of the Yellow Cab Manufacturing Co., which position he held until the merger with General Motors Truck Corporation in 1925.

EDWIN H. PIERCE, formerly vice-president and general manager of the Niles Tool Work Co., Hamilton, Ohio, has been made vice-president and general manager of the Atwood Machine Co., Stonington, Conn., manufacturer of silk and rayon throwing machinery. Previous to the above connection, he was for many years with the United States Steel Corporation as superintendent of the New Haven Works, and as superintendent of the South Works (Worcester, Mass.) of the American Steel and Wire Co. Mr. Pierce is a director of the Atwood firm and also remains a director of the Niles-Bement-Pond Company.

JAMES A. FARRELL, president of the United States Steel Corporation, was presented with the Gary Medal of the American Iron & Steel Institute at its general meeting in New York on May 24 for his accomplishments and service to industry, the greatest of which has been his activities in extending foreign trade.

CHARLES S. CRAWFORD, a member of the regional staff of General Motors Corporation, has been appointed to the post of chief engineer of the Adam Opel Co., subsidiary of General Motors, located at Russelsheim, Germany. Prior to his connection with General Motors, he was chief engineer of the Stutz Motor Car Company.

SEYMOUR J. BAUM, former manager of the Aircraft Division of Brewster & Co., has formed a new organization known as Seymour J. Baum, Inc., located at 268 Albion St., Elmhurst, L. I. This concern will manufacture flotation gear of wood, metal, or composite construction of any type for aircraft.

T. G. BEAMENT has resigned as sales manager of Joliette Steel, Ltd., Mont. manager of Joliette Steel, Ltd., Montbranch manager for Wm. Hamilton Co., Ltd., of Peterboro, Ont. Prior to his connection with Joliette Steel, he was with the Taylor-Wharton Iron and Steel Co., at High Bridge, N. J.

EDGAR C. BAIN, of the U. S. Steel Laboratories, Kearny, N. J., was elected chairman of the New York Chapter of the A.S.S.T. for the vear 1929-30, at the annual meeting on May 20. Mr. Bain succeeds Francis F. Lucas, metallurgist of the Bell Telephone Laboratories, in the chairmanship.

A. W. GABELEIN, who for eight years has been Eastern representative of the machinery division of the New Britain Machine Co., will devote his full time to the selling of screw machine products and shop furniture made by the company, which recently turned over its machinery business to the New Britain-Gridley Machine Co. The sales of the New Britain-Gridley machines will be handled directly by the New Britain office.

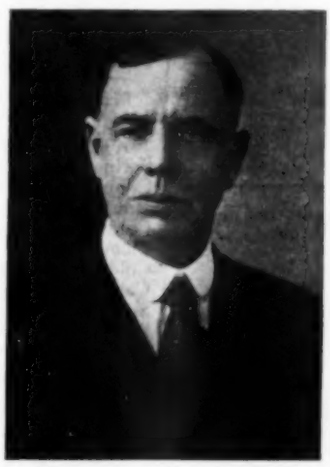
F. O. WEBER, 229 Boulevard Des Allies, Pittsburgh, Pa., has been appointed sales manager for the Pittsburgh district of the Fusion Welding Corporation, 103rd St. and Torrence Ave., Chicago, manufacturer of welding equipment and supplies.

RUSSELL S. BEGG, formerly chief engineer of the Jordon Motor Car Co., of Cleveland, has been appointed chief engineer of the Stutz Motor Car Co. of Indianapolis.

JOSEPH MONAHAN, machine tool distributor, Grand Rapids, Mich., has moved his office to 321 Lake Michigan Drive (Shawmut Blvd.).

Obituaries

FRANK BURGESS, president of the Boston Gear Works, Inc., Norfolk Downs, Quincy, Mass., died at his home in Wollaston on May 18. He was born in Natick, Mass. in 1860. His first job was as gymnasium instructor at the Detroit Y.M.C.A. in 1879 and after one year he was employed by the Union Switch and Signal Co. and later by the Gamewell Fire Alarm C. of Newton, Mass. He then began work



in 1890 for George B. Grant, the founder of the Boston Gear Works. In 1891 Mr. Burgess purchased the Boston Gear Works and has since developed it to its present size.

HENRY W. BLAKE, senior editor of *Electric Railway Journal*, a McGraw-Hill publication, died at his home in Englewood, N. J., on May 20. He was a pioneer in the field of business journalism devoted to street railway transportation. In 1891 he joined the editorial staff of *Street Railway Journal*, then a publication devoted to horse car transportation. In 1894 he became editor-in-chief and was still with the publication when in 1908 its name was changed to *Electric Railway Journal*. Mr. Blake continued his editorial connection with that paper without interruption until his death. He was active in the affairs of the American Electric Railway Association and was a member of the American Institute of Electrical Engineers and the Engineers Club o New York. He was an associate mem ber of the Union Internationale d Tramways et de Chemins de Fe

d'interet local of Brussels. James H. McGraw, publisher of the *Electric Railway Journal*, said of Mr. Blake that in recognizing that the editor's responsibility is not merely to present current new and opinions but to provide a vehicle for advancing thought, Mr. Blake stamped the imprint of his mind and personality indelibly upon the paper and the industry to which his life was devoted.

CHARLES HILLARD HANSON, president of the Boston Steel Manufacturing Co., Malden, Mass., died May 20 at his home in Melrose, following an extended illness. Mr. Hanson was 79 years of age and a native of Boston. He had been connected with the steel company since 1914.

CALVIN W. VAUGHN, 70, president of the Vaughn Machinery Co., Cuyahoga Falls, Ohio, died recently of a heart attack.

Forthcoming Meetings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Semi-annual meeting, Salt Lake City, Utah, July 1-4. Third national meeting of the Iron and Steel Division, during the Steel Treaters' Exposition, Cleveland, September 11-13. Calvin W. Rice, secretary, 29 West 39th St., New York City.

NATIONAL ASSOCIATION OF PURCHASING AGENTS. Annual meeting, June 3-6, at Buffalo. G. A. Renard, secretary, 11 Park Place, New York.

AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting, June 24-28, at the Chalfonte-Haddon Hall, Atlantic City, N. J. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia, Pa.

SOCIETY OF AUTOMOTIVE ENGINEERS. Summer meeting, Saranac Inn, Upper Saranac Lake, N. Y., June 25-28. Coker F. Clarkson, manager, 29 E. 39th St., New York.

The Weekly Price Guide

Rise and Fall of the Market

PRICE changes are few, compared with last week's levels in the principal shop materials and supplies listed here. It is expected by dealers that steel prices will remain unchanged throughout the next quarter. Output is proceeding at a high rate with demand showing but little tendency to recede. Minimum quotations on steel sheets at Pittsburgh mill are down 10c. per 100 lb., this week. The principal advances since May 17 are a rise of 0.4c. per lb. (11.4c.) in linseed oil at Chicago and one amounting to 0.1c. per lb. (6.65c.) on slab zinc at East St. Louis.

(*All prices as of May* 24, 1929)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b:

CINCINNATI	
No. 2 Southern (silicon 1.75@2.25)	$18.94
Northern Basic	20.89
Southern Ohio No. 2	21.19
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 1.75@2.25)	21.25
BIRMINGHAM	
No. 2 Foundry (silicon 1.75@2.25)	15.50
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.76)	21.76
Virginia No. 2	24.79
Basic	20.76
CHICAGO	
No. 2 Foundry local (silicon 1.75@2.25)	20.00
No. 2 Foundry, Southern (silicon 1.75@2.25)	21.26
PITTSBURGH, including freight charge ($1.76) from Valley:	
No. 2 Foundry	20.26
Basic	20.26
Bessemer	20.76

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb:

Detroit	4.50
Cleveland	5.00
Cincinnati	4.50
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots:

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.10@2.20	3.35	3.25	3.90*
No. 12	2.15@2.25	3.40	3.30	3.95*
No. 14	2.25@2.35	3.45	3.35	4.00*
No. 16	2.35@2.45	3.55	3.45	4.10*
Black				
Nos. 18 to 20	2.65@2.75	3.85	3.70	3.80
No. 22	2.80@2.90	4.00	3.85	3.95
No. 24	2.85@2.95	4.05	3.90	4.00
No. 26	2.95@3.05	4.15	4.00	4.10
No. 28	3.10@3.20	4.75	4.15	4.25
Galvanized				
No. 10	2.80@2.90	4.20	4.05	4.05
Nos. 12 to 14	2.90@3.00	4.30	4.15	4.15
No. 16	3.00@3.10	4.40	4.25	4.25
No. 18	3.15@3.25	4.55	4.40	4.40
No. 20	3.30@3.40	4.70	4.60	4.55
No. 22	3.35@3.45	4.75	4.65	4.60
No. 24	3.60@3.70	4.90	4.75	4.75
No. 26	3.75@3.85	5.15	5.00	5.00
No. 28	4.00@4.10	5.40	5.25	5.25

*Up to 3,999 lb.

WELDED STEEL PIPE—Warehouse discounts are as follows

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Glav.
1 to 3 in., butt welded	50%	36%	55½%	43½%	54%	41%
2½ to 6 in., lap welded	45%	32%	53½%	40½%	51%	38%

WROUGHT-STEEL PIPE LIST

Size, Inches	List Price per Foot	—Diameter in Inches— External	Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb:

— Thickness — B.w.g. and Decimal Fractions		Outside Diameter in Inches ⅛	¼	⅜	½	1	1¼	1½
		Price per Foot						
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
.065″	16	.19	.20	.21	.22	.23	.25	.27
.083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109″	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse base prices in cents per lb:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.25†	4.00	4.15
Cold rolled strip steel	6.25	6.00	6.10
Floor plates	5.10†	5.30	5.00
Cold drawn, round or hexagon‡	3.50	3.65	3.60
Cold drawn, flat or square‡	4.00	4.15	4.10
Structural shapes	3.30†	3.00	3.10
Soft steel bars	3.25†	3.00	3.00
Soft steel bar shapes	3.25†	3.00	3.00
Soft steel bands	3.75†	3.65	3.65
Tank plates	3.30†	3.00	3.10
Bar iron (2.75 at mill)	3.24	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, $\frac{3}{16}$-in. thick. †Up to 3,999 lb., ordered and released for shipment at one time. ‡Cold finished steel, shafting and screw stock.

Electric welding wire at New York warehouse— $\frac{3}{32}$, 8.35c. per lb.; $\frac{1}{8}$, 7.85c. per lb.; $\frac{5}{32}$ to $\frac{1}{4}$, 7.35c. per lb.

METALS

Warehouse Prices in Cents Per Pound for Small Lots:

Copper, electrolytic, New York			19.25
Tin, Straits, pigs, New York			47.00
Lead, pigs, E. St. Louis	6.80	New York	8.25
Zinc, slabs, E. St. Louis	6.65	New York	8.25

	New York	Cleveland	Chicago
Antimony, slabs	11.50	13.50	14.25
Copper sheets, base	27.75	27.75	27.75
Copper wire, mill, base	19.87½	19.87½	19.87½
Copper, drawn, round, base	26.25	26.25	26.25
Copper tubing, base	29.25	29.25	29.25
Brass sheets, high, base	23.25	23.25	23.25
Brass tubing, high, base	28.25	28.25	28.25
Brass rods, high, base	21.25	21.25	21.25
Brass wire, high, base	23.75	23.75	23.75

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%.....	25.00*	24.30	24.30
Zinc sheets (casks).....	10.50@11.00	11.70	10.11
Solder (½ and ½).....	32.50	32.75	31@34
Babbitt metal, delivered in case lots, New York, cents per lb:			
Genuine, highest grade.....			61.00
Commercial genuine, intermediate grade.....			45.00
Anti-friction metal, general service.....			31.50
No. 4 babbitt.....			12.00

*Delivered.

NICKEL AND MONEL METAL—Price in cents per lb., base, f.o.b. Huntington, W. Va:

	Nickel	Monel Metal
Sheets, full finished.....	52.00	42.00
Sheets, cold rolled.....	60.00	50.00
Strip, cold rolled.....	55.00	45.00
Rods, hot rolled.....	45.00	35.00
Rods, cold rolled.....	53.00	40.00†
Tubing.....	75.00*	90.00
Angles, hot rolled.....	50.00	40.00
Plates.....	52.00	42.00

*Seamless. †Cold drawn.

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars, depending on quantity offered for sale:

	New York	Cleveland	Chicago
Crucible copper.....	13.50 @13.75	13.50	13.00 @14.00
Copper, heavy, and wire..	13.50 @13.75	13.00	12.00 @13.00
Copper, light, and bottoms	12.00 @12.25	12.50	11.00 @12.00
Heavy lead.....	5.12½@ 5.62½	6.25	5.00 @ 5.50
Tea lead.....	2.37½@ 2.87½	4.25	4.00 @ 4.50
Brass, heavy, yellow.....	9.00 @ 9.25	8.00	8.00 @ 8.50
Brass, heavy, red.....		12.50	12.00 @12.50
Brass, light.....	7.37½@ 7.50	7.50	8.00 @ 8.50
No. 1 yellow rod turnings.	9.25 @ 9.50	9.00	10.00 @10.50
Zinc.....	3.75 @ 4.00	3.25	3.00 @ 3.25

TIN PLATES—Charcoal—Bright—Per box:

	New York	Cleveland	Chicago
"AAA" Grade:			
IC, 14x20.....	$12.10	$11.95	$11.50
"A" Grade:			
IC, 14x20.....	9.70	9.90	9.50
Coke Plates—Primes—Per box:			
100-lb., 14x20.....	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:			
IC, 14x20.....	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.*	$0.10@0.13½	$0.16	$0.15
Cotton waste, colored, per lb.*	.09@ .13	.12	.12
Wiping cloths, washed white, per lb.†.....	.16	38.00 per M	.16
Sal soda, per lb.....	.02½	.02	.02
Roll sulphur, per lb.....	.027	.03½	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.....	.111	.11	114
Cutting oil, about 25% lard, in 5 gal. cans, per gal.....	.55	.60	.65
Machine oil, medium-bodied (55 gal. steel bbl.) per gal..	.33	.36	.35
Belting — Present discounts from list in fair quantities (½ doz. rolls) for leather or rubber:			
Leather—List price, 24c. per lin. ft., per inch of width, for single ply:			
Medium grade.....	30–10%	30–10%	35%
Med. grade, heavy wgt...	30– 5%	30– 5%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft:			
First grade.....	50%	50–10%	50%
Second grade.....	60%	60– 5%	50–10%

*All waste in bale lots. †100-lb. bales.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars.....	per lb..	$0.0325	$0.0325	$0.0325
Cold drawn shafting...	per lb..	.035	.035	.034
Brass rods.....	per lb..	.2125	.2487½	.1675
Solder (½ and ½).....	per lb..	.325	.35	.3375
Cotton waste, white...	per lb..	.10@.13½	.10@.13½	.10@.13½
Disks, aluminum oxide mineral, cloth, No. 1, 6-in. dia.....	per 100.	3.60	3.60	3.10
Lard cutting oil.....	per gal.	.55	.55	.65
Machine oil.....	per gal.	.33	.33	.30
Belting, leather, medium.....	off list..	30–10%	30–10%	35%
Machine bolts, up to 1x30 in., full kegs...	off list..	50-10%*	50–10%*	50%*

*List prices as of April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper.....	$4.50	$4.29	$4.29
Emery cloth.....	22.93	20.97	20.97
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper.....	2.64	2.04	2.04
Cloth.....	3.60	3.59	3.59
Fire clay, per 100 lb. bag.....	1.00	.75	.75
Coke, prompt furnace, per net ton...	Connellsville,		2.75@2.85
Coke, prompt foundry, per net ton...	Connellsville,		3.75@4.50
White lead, dry or in oil...	100 lb. kegs....	New York,	13.75
Red lead, dry.....	100 lb. kegs....	New York,	13.75
Red lead, in oil.....	100 lb. kegs....	New York,	15.25

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

Machine bolts:	
Up to ¾-in. x 6-in., full kegs, list less.....	60%
Larger, up to 1 x 30-in., full kegs, list less.....	50–10%
Less than full kegs or case lots, add to list.....	10%
Fitting-up bolts: list less.....	45%
Lag screws:	
Up to ½-in. x 6-in., list less.....	60%
Larger, list less.....	50–10%
Less than full keg or case lots, add to list.....	10%
Rivets:	
Structural, round head, full kegs, net.....	$4.50
Structural, round head, broken kegs, net.....	6.00
Tank, $\frac{7}{16}$-in. dia. and smaller, list less.....	60%
Nuts:	
Hot pressed, square or hexagonal, blank or tapped:	
Full kegs up to 1-in., incl., list less.....	60%
Larger, up to 3-in., list less.....	40–10%
Less than keg or case lots, add to list.....	10%
Washers:	
Wrought, full kegs, per 100 lb., list less.....	$4.00
Wrought, broken kegs, per 100 lb., list less.....	2.00
Turnbuckles:	
With stub ends, list less.....	20%
Without stub ends, list less.....	50%
Chain:	
Proof coil, base, per 100 lb., net.....	$7.10
Cast iron welding flux, per lb., net.....	.40
Brazing flux, per lb., net.....	.80

Machine Requirements and Industrial Construction

Equipment Wanted

Mich., Lansing—Olds Motor Works, Olds Ave., miscellaneous machine shop equipment for finishing motor parts.

Mich., Detroit — Paner Stamping Co., 3729 Crane Ave.—medium duty press and equipment.

Mich., Zilwaukee — National Valve & Mfg. Co., c/o Consumers Power Co., power machine pipe cutter for sizes 2 to 6 in.

O., Cleveland—M. Gross, 4656 Broadview—motor driven woodworking machine.

O., East Liverpool—Patterson Foundry & Machine Co.—10 or 15 ton overhead electric crane.

Ont., Toronto—Toronto Dye Co., 297 Adelaide St.—machinery and equipment for machine shop.

Opportunities for Future Business

Ala., Gadsden—Gulf States Steel Co., L. E. Geohegan, V. Pres. and Gen. Mgr., B.-M. Bldg., Birmingham, awarded contract for the construction of a plate mill here. Estimated cost $1,500,000.

Calif., Los Angeles—Perfect Caster Mfg. Co., 3517 East 11th St., Long Beach, plans the construction of a factory here.

Calif., Merced — M. V. Doran, awarded contract for a 150 x 1,008 ft. garage at Court House Ave. and 18th St. Estimated cost $30,000.

Conn., Greenwich—Allen Bros. Garage Inc., 140 Greenwich Ave., awarded contract for a 3 story garage. Estimated cost $50,000.

Conn., Noroton — State Bd. of Finance State House, Hartford, plans a 2 story, 40 x 140 ft. service building including carpenter and electric shops, etc. at Fitch Home for Soldiers here. Estimated cost $90,000. Architect not selected.

Ill., Chicago—American Iron & Wire Co., 1622 Carroll Ave., manufacturers of wire partitions, machine guards, office cages, etc., awarded contract for a 2 story, 35 x 124 ft. warehouse. Estimated cost $30,000.

Ill., Harvey—Whiting Corp., c/o H. M. Rowlette, Prod. Mgr., is having preliminary plans prepared for a 1 story addition to plant for the manufacture of cranes, foundry, equipment, railway specialties, etc. Estimated cost $100,000. Perkins, Chatten & Hammond, 160 North La Salle St., Chicago, Archts.

Ill., Rantoul—U. S. Army, Chanute Field, is having preliminary plans prepared for improvements to air field including hangar, shop, etc. Estimated cost $252,700. Private plans.

Ill., Rockford—Barber Colman Co., awarded contract for a 1 story, 50 x 129 ft. forge shop on River St. Estimated cost $45,000.

Ill., St. Charles—Thomas Engineering Mfg. Co., 616 South Michigan Ave., Chicago, manufacturers of radio condensers and parts, will soon award contract for a 2 story, 50 x 125 ft. factory here. Estimated cost $50,000.

Ill., Scott Field (mail Belleville)—U. S. War Dept., is having preliminary plans prepared for improvements to air field including hangar, shop, warehouse, etc. Estimated total cost $508,000.

Ind., Auburn—Auburn Auto Co., C. L. Cord, Pres., is receiving bids for the construction of a factory. Estimated cost $60,000. A. M. Strauss, 415 Cal-Wayne Bldg., Archt.

Ind., Evansville—W. C. Sanderson, 218 South Water St., awarded contract for a 3 story, 150 x 150 ft. garage at 3rd St. between Locust and Walnut Sts. Estimated cost $175,000.

Ind., Indianapolis — Pierre & Wright, 1133 Hume-Manuser, Archts., awarded contract for the construction of a service station at 24th and Meridian Sts. Estimated cost $49,000. Owner not announced.

Ind., Indianapolis — Western Oil Co., 310 North Meridian St., awarded contract for a machine shop and service station at Market and East Sts. Estimated cost $41,200.

Me., Auburn — Twin City Motor Co., c/o Webster & Libby, 443 Concord St., Portland, Archts., is having plans prepared for a 2 story, 50 x 100 ft. repair and service garage. Estimated cost $50,000.

Mass., Beverly—P. Trembley, 381 Cabot St., is having preliminary plans prepared for a 1 story repair and service garage on Rantoul St. Estimated cost $40,000. Private plans.

Mass., Concord — City, W. Blanchard, Chn. Bldg. Comm., will soon award contract for a 3 story school including shops, etc. Estimated cost $250,000. Kilham, Hopkins & Greeley, 9 Park St., Boston, Archts.

Mass., Fairhaven—Fairhaven Iron Foundry, L. W. Morton, Treas., 2 Water St., plans to rebuild 1 and 2 story, 50 x 100 ft. foundry. Estimated cost $40,000. Private plans.

Mass., Melrose—Dakin & Grant, 10 Elsworth Ave., awarded contract for a 1 story repair and service garage at Tremont and Melrose Sts. Estimated cost $40,000.

Mass., Jamaica Plain (sta. Boston) — Forest Hills Cemetery, H. S. Adams, Supt., Forest Hills Ave., awarded contract for a 1 and 2 story, 25 x 120 and 60 x 75 ft. garage and repair shop. Estimated cost $50,000.

Mass., New Bedford—Norlander Machine Co., 463 South First St., awarded contract for a 1 story machine shop. Noted Apr. 25.

Mass., North Adams—S. Shapiro, 35 Union St., awarded contract for a 2 story, 45 x 105 ft. repair and service garage on Eagle St. Estimated cost $45,000.

Mass., Pittsfield—R. Sarro, c/o J. Winchell, 144 Wahconah St., is having revised plans prepared for a 2 story, 60 x 120 ft. garage on Fenn St. Estimated cost $45,000. Noted Feb. 14.

Mass., Quincy (Boston P. O.)—C. B. Yule & Son, 1626 Hancock St., is having sketches made for a 2 story, 100 x 100 ft. repair and service garage at 676 Hancock St. E. T. P. Graham, 171 Newbury St., Boston, Archt.

Mass., Walpole — Giles Bros., Massachusetts Ave., will build a 1 story, 50 x 150 ft. repair and service garage on Main St. Estimated cost $40,000. Private plans.

Mich., Detroit—Dept. of Public Works, City Hall, is having new plans prepared for a 1 and 2 story airport hangar, exposition building, repair shops, etc. on Gratiot Ave. Estimated cost $1,000,000. P. A. Fellows, City Hall, Engr. Noted Jan 31.

Mich., St. Joseph—Auto Specialties Mfg. Co., J. W. Tiscornia, V. Pres. and Gen. Mgr., Edgewater St., is having plans prepared for a 1 story addition to foundry. F. E. Davidson, 53 West Jackson Blvd., Chicago, Ill., Archt. and Engr.

Mo., North Kansas City (br. Kansas City)—Curtis Harvesters Inc., plans a 2 story, 225 x 400 ft. harvester combine factory here. Estimated cost $250,000. McKecknie & Trask, Bd. of Trade Bldg., Kansas City, Archts.

N. J., Maplewood — Kroydon Co., Burnett Ave., will receive bids about June 15, for a 1 story, 30 x 150 ft. factory for the manufacture of golf clubs. Estimated cost $40,000. D. A. Hopper, 22 Ridgewood Ave., Irvington, Archt. Noted Mar. 21.

N. J., Newark—American Platinum Works, 231 New Jersey Railroad Ave., will readvertise for bids soon for a 4 story, 40 x 125 ft. addition to factory at Oliver St. and New Jersey R.R. Ave. Estimated cost $50,000. F. A. Phelps, 21 Fulton St., Archt.

N. J., Newark—E. C. Epple, 44 Commerce St., Assoc. Archt., will receive bids about June 15 for a 3 story, 20 x 200 ft. factory at Central Ave. at 16th to 17th Sts. for Packard Motor Car Co., Broadway and 61 St., New York, N. Y. Estimated cost $300,000. A. Kahn, 1000 Marqueete Bldg., Detroit, Mich., Archt. Noted May 16.

N. J., Newark—Mauer Steel Barrel Co., Long Island City, N. Y., awarded contract for a 1 story, 175 x 300 ft. plant at Ave. L and St. Charles St. Estimated cost $150,000.

N. J., Paterson—Wright Aeronautical Co., 139 Railway Ave., plans a 1 story addition to plant on Madison Ave. Estimated cost $750,000. Architect not selected.

N. J., Trenton—Dept. of Institutions & Agencies, awarded contract for a 3 story industrial shop for criminal insane building at State Hospital.

N. J., Trenton—C. D. Wilson, Poe Rd., Princeton, plans the construction of a garage here. Estimated cost $50,000. Tex Wrecking Co., 5-11 Lafayette St., Trenton, lessee.

N. Y., Brooklyn—M. Amorosa, 1724 68th St., plans the construction of a garage at 67th St. and West 18th Ave. Estimated cost $40,000. M. J. Ort, 424 East 149th St., New York City.

N. Y., Brooklyn—H. Gilman, c/o C. P. Colla, 44 Court St., Archt., will receive bids in Sept. for the construction of a garage at Montrose Ave. and Humboldt St. Estimated cost $40,000.

N. Y., Brooklyn—J. Sternberg, 1116 Ave. H., awarded contract for the construction of a garage at 131 East 12th St. Estimated cost $75,000.

N. Y., Brooklyn—H. Weil Inc., 201 Eastern Parkway, plans the construction of a 3 story, 50 x 100 ft. garage at Carlton Ave. and Fulton St. Estimated cost $50,000. Becca & Ungarluder, 186 Remsen St., Archts.

N. Y., Brooklyn — E. A. Wildermuth, 1057 Atlantic Ave., will soon award contract for a 1 story garage at Atlantic and Franklin Aves. Estimated cost $150,000. Slee & Bryson, 160 Montague St., Archts.

N. Y., Brooklyn — Yarin Realty Corp., M. Tucker, Pres., Jamaica, will build a 2 story, 90 x 95 ft. garage at Grant and DeKalb Aves. here. Estimated cost $85,000. W. F. Regan, 72 Willoughby St., Archt.

N. Y., Long Island—Constructing Quartermaster, U. S. Gov't., Mitchel Field, will receive bids until June 14 for the construction of a group of buildings including machine shop, assembly hangar, etc. at Air Corps Barracks.

N. Y., Long Island City—J. Wagner, 147-47 Jasmine Ave., Flushing, plans a 92 x 1185 ft. machine shop at 11th St. and 36th Ave. here. Estimated cost $45,000. F. O'Rourke, 29-28 Hunters Point Ave., Long Island City, Archt.

N. Y., New York—New York Central R.R., 466 Lexington Ave., plans a 7 story, 200 x 200 ft. automobile shop and garage at 300 West 15th St. Estimated cost $900,000. F. B. Freeman, Ch. Engr.

N. Y., New York—J. & W. Scott Cameron, 19 Cedar St., plan the construction of a garage and sales and service station at 418 West 125th St. Estimated cost $50,000. Engineering Drafting Co., 47 West 42nd St., Archt.

N. Y., New York — Second Ave. and 91st Realty Corp., I. Ehrman, Pres., 41 Park Row, awarded contract for the construction of a garage at 431 East 71st St. Estimated cost $60,000. Noted Mar. 14.

N. Y., Oswego—Bates Valve Bag Corp., c/o W. A. Crandon, awarded contract for a 200 x 450 ft. machine shop.

N. Y., St. George—N. Antico, c/o J. Whitford, 56 Broadway, had plans prepared for a 50 x 85 ft. garage at Montgomery Ave. and Victory Blvd. Estimated cost $40,000.

N. Y., St. George—Island Auto Sales Co., 1020 Castleton Ave., awarded contract for a 2 story garage, etc. at Castleton Ave. and Clove Rd. Estimated cost $45,000.

N. Y., Syracuse—Owner, c/o C. Park, Merchants National Bank Bldg., Archt., awarded contract for a 2 story garage on East Raynor St. Estimated cost $48,200.

O., Canton—Highway Dept., R. N. Waid, Dir., Ohio-Hartman Bldg., will soon award contract for a 1 story, 40 x 123 ft. garage. Estimated cost $40,000. H. B. Briggs, Ohio-Hartman Bldg., Columbus, Archt.

Okla., El Reno — Chicago, Rock Island & Pacific R.R., La Salle St. Station, Chicago, Ill., awarded contract for a 60 x 80 ft. mill building, office and reclamation house, etc. here Estimated total cost $56,746.

Pa., Philadelphia—F. A. Cruice, 21st St. and Ridge Ave., manufacturer of mantels, plans an 80 x 128 ft. factory at Wakefield and Germantown Aves. Estimated cost $90,000. F. D. Edmunds, Real Estate Trust Bldg., Archt.

Ont., Penetanguishene—Dominion Stove & Foundry Co., plans a 1 story addition to stove and foundry plant. Estimated cost $50,000. Private plans.

Ont., Welland—Canadian Foundries Ltd., plans the construction of a plant.

Ont., Toronto — A. D. Gorrie & Co., 354 Victoria St., awarded contract for a 2 story, 100 x 104 ft. garage on Yonge St. Estimated cost $200,000.